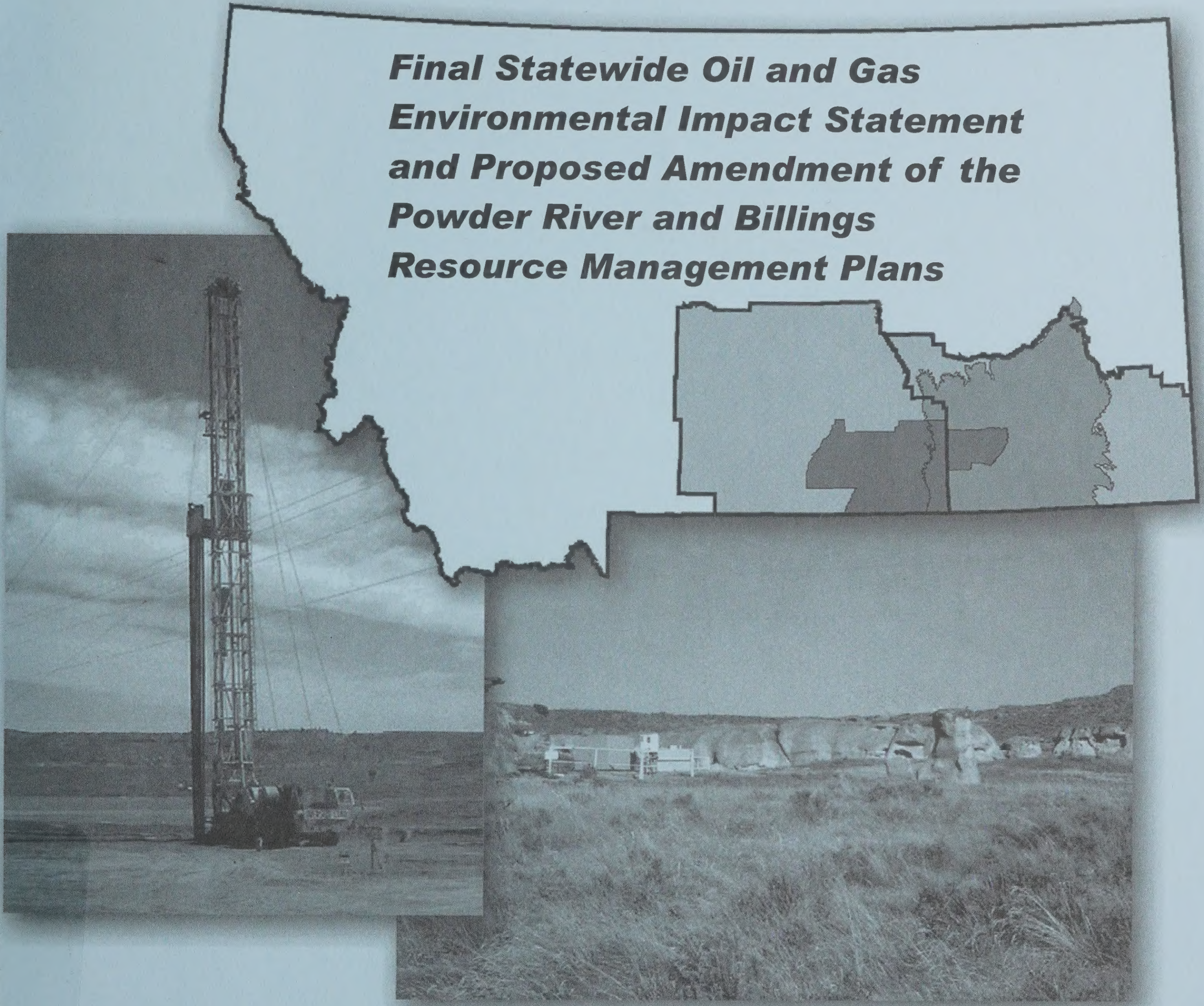
BLM LIBRARY
88067201

United States Department of the Interior
Bureau of Land Management
Miles City Field Office
Billings Field Office
State of Montana
Montana Board of Oil and Gas Conservation
Montana Department of Environmental Quality

January 2003

MONTANA

Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans



VOLUME I

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation; rangelands; timber; minerals; watershed; fish and wildlife; wilderness; air; and scenic, scientific, and cultural values.

BLM/MT/PL-03/005

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

BUREAU OF LAND MANAGEMENT
Miles City Field Office
111 Garryowen Road
Miles City, Montana 59301-0940
http://www.mt.blm.gov/mcfo/

IN REPLY TO: 1310

Dear Reader:

The Bureau of Land Management (BLM), and the State of Montana, Department of Environmental Quality (MDEQ) and Board of Oil and Gas Conservation (MBOGC), have prepared the *Montana Final Statewide Oil and Gas Environmental Impact Statement (FEIS) and Proposed Amendment of the Powder River and Billings Resource Management Plans.* The Bureau of Indian Affairs, Crow Tribe, Department of Energy and the Environmental Protection Agency (EPA) are designated Cooperating Agencies in the EIS. The Northern Cheyenne Tribe declined to become a cooperating agency, but was invited by BLM to participate in all cooperating agency activities. Consultation with both the Crow and Northern Cheyenne tribes has taken place throughout the process to gather their input and concerns. Consultation with the U.S. Fish and Wildlife Service has also occurred. The BLM has also met with individuals from the public, special interest groups, industry, and local governments upon their request.

The FEIS and Proposed Amendment documents and discloses the results of the environmental analysis of anticipated coal bed methane and conventional oil and gas development in the State of Montana. The FEIS amends the State s 1989 *Programmatic Environmental Impact Statement on Oil and Gas Drilling and Production in Montana* to include coal bed methane exploration and production activities on private and state-owned lands. You may view the *Montana Final Statewide Oil and Gas Environmental Impact Statement (FEIS) and Proposed Amendment of the Powder River and Billings Resource Management Plans* on the following BLM, DEQ and MBOGC websites: http://www.mt.blm.gov/mcfo , and http://www.deq.state.mt.us/, and http://www.bogc.dnrc.state.mt.us/. Copies of the FEIS and Proposed Amendment are also available for public inspection at the following BLM and State offices:

Bureau of Land Management
Montana State Office
5001 Southgate Drive
Billings, Montana 59107

Bureau of Land Management
Miles City Field Office
111 Garryowen Road
Miles City, Montana 59301

Board of Oil and Gas Conservation
2535 St. Johns Avenue
Billings, Montana 59102

We recommend that you begin by reading the Summary of the FEIS and Proposed Amendment, which will orient you to the general outline of the document.

The BLM and the State have identified Alternative E as the Preferred Alternative for managing the State and BLM oil and gas activities. The Preferred Alternative provides for responsible management of coal bed methane in consideration of other resources. Although Alternative E is the preferred alternative for the State and BLM, each agency will issue its own Record of Decision to approve management decisions.

In the document, the word State refers to the appropriate State of Montana agency(s). State agencies have different jurisdictions, so the term State is used generically . For example, State can mean the Department of Natural Resources and Conservation or Fish, Wildlife, and Parks.

The Draft EIS (DEIS) was made available for public review and comment from February 15, 2002 through May 15, 2002. More than 18,000 letters, emails, faxes and cards were received. In response to the comments, a variety of changes were made throughout the document, including correction of errors, updating information on the MDEQ s permitting process for produced waters, clarifying and providing more detail on the alternatives, revising some of the models used to predict environmental effects, and providing some additional information concerning biological resources.

The BLM in Wyoming has also issued a FEIS that addresses oil and gas development in the Wyoming portion of the Powder River Basin. More information on the *FEIS and Proposed Planning Amendment for the Powder River Basin Oil and Gas Project* can be found at BLM website http://www.prb-eis.org.

To prepare the FEISs, BLM Montana and Wyoming worked cooperatively with the EPA and the Wyoming and Montana DEQs to ensure consistency where appropriate and improve the air and surface water quality impact analysis methods. For example, the agencies agreed to use common analytical assumptions and prepared a joint cumulative impact assessment for surface water based on information provided by the US Geological Survey (USGS). The Wyoming FEIS includes an updated air quality analysis that is consistent with the model used in the Montana FEIS. Both documents include an expanded section on water and air quality monitoring and the roles and responsibilities of the agencies in regards to issuing permits for water discharges and air emissions. Both documents describe in more detail some of the mitigation options available to the permitting agencies to ensure compliance of all activities with the Clean Air Act and Clean Water Act.

Where differences in certain analytical assumptions are still warranted, the rationale for the assumption is better explained in the FEISs. For example, both EISs now use 6.2 gallons per minute as the figure for water production from coal bed methane wells during the time of maximum total field water production, and impacts are calculated based upon this maximum water production rate. However, because the Montana FEIS and Proposed Amendment covers all lands within the state of Montana and since there is data on Montana wells outside the Powder River Basin that indicate such wells may last up to 20 years, the Montana FEIS and Proposed Amendment continues to note a 2.5 gpm average for water production over a 20 year period.

Some reviewers of the Draft EISs suggested the EISs be combined because of their similarities and to better address cumulative effects. The Final EISs are being issued separately primarily because the documents involved different cooperators and co-leads with independent jurisdictions and legal responsibilities. In addition, the Montana FEIS and Proposed Amendment covers the entire state of Montana while the Wyoming FEIS addresses only lands within the Wyoming portion of the Powder River Basin. Finally, most of the information and analyses presented in the documents is specific to the lands and resources within each state, or as is the case for the surface water quality analysis, individual watersheds. To combine such a volume of information would have made the documents impracticable to read and to address issues over such an extensive area would have made it extremely difficult to identify the information relevant to the decisions to be made in each state by each agency.

Some reviewing agencies suggested the BLM issue a Supplemental Draft EIS due to the extensive nature of the comments provided by the reviewing agencies. Largely due to the coordinated efforts of the BLM, EPA, Montana co-leads and Wyoming DEQ to be responsive to public comments, numerous changes were made in the FEISs, as noted above. BLM carefully evaluated the need to issue a supplement and determined that though the FEISs have been greatly improved since the Draft EISs, the agency did not make substantial changes in the preferred alternative. In addition, some information was included in the Final EISs that was not available when the Draft EISs were released. However, BLM determined that there were no significant new circumstances or information relevant to environmental concerns and bearing on the preferred alternative or its impacts. Therefore, the BLM is not required to prepare a supplement to the Draft EISs.

The MBOGC will hold a public hearing on the FEIS. This hearing is expected to take place at the February 2003 regularly scheduled Board hearing in Billings. In addition to the customary meeting notices the Board s meeting schedule is available at its website: http://www.bogc.dnrc.state.mt.us/. Subsequent to the public hearing, the Board will issue its own (separate from BLM) Record of Decision.

The BLM Planning Regulations, 43 CFR 1610.5-2, state that any person who participated in the planning process and has an interest which may be adversely affected may file a protest with the BLM Director. A protest may only raise those issues which were submitted for the record during the planning process. The protest shall be filed within 30 days of the date the EPA publishes the notice of receipt of the *Montana Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans* in the *Federal Register*. See information pertaining to the BLM protest procedures on the page following the Dear Reader letter.

The decisions associated with the FEIS and Proposed Amendment are not the final reviews and approvals for actions associated with coal bed methane development in Montana. The BLM and the State must conduct the appropriate level of environmental review prior to approving the various components of the plan that involve ground disturbance. At the time such approvals are granted, those decisions will be subject to administrative reviews according to the applicable regulations of the approving agency.

Please retain this copy of the FEIS and Proposed Amendment for future reference. If you have any questions or require additional copies of the document, please call the Coal Bed Methane Hotline at 406-233-3649. We appreciate your interest in the management of the public lands.

Sincerely,

Jan P Sensibaugh

Jan P. Sensibaugh
Montana Department of Environmental Quality

Tom Richmond
Montana Board of Oil and Gas Conservation

David McIlnay

David McIlnay
Bureau of Land Management

BLM Protest Procedures

All protests must be sent in writing to:

Regular Mail
Director, Bureau of Land Management
Attention: Ms. Brenda Williams, Protest Coordinator
P.O. Box 66538
Washington D.C. 20035

Overnight Mail
Director, Bureau of Land Management
Attention: Ms. Brenda Williams, Protest Coordinator
1620 L Street, N.W., Room 1075
Washington, D.C. 20036
[Phone: 202-452-5045]

Protests filed late, or filed with the State Director, or Field Manager, shall be rejected.

There is no provision for any extension of time for the 30-day protest period provided in the planning regulations.

The resolution of protests is the responsibility of the Director of the BLM whose decision is the final decision of the Department of the Interior. The decision will be in writing and set forth the reasons for the decision. The decision will be sent to the protesting party by certified mail, return receipt requested.

The Planning Regulations at 43 CFR 1610.5-2, state that the protest shall contain:

1) The name, mailing address, telephone number, and interest of the person filing the protest.

2) A statement of the issue or issues being protested.

3) A statement of the part or parts of the plan being protested.

4) A copy of all documents addressing the issue or issues that were submitted during the planning process by the protesting party or an indication of the date the issue or issues were discussed for the record.

5) A concise statement explaining why the State Director s decision is believed to be wrong.

#52900698
1D88067201
HD
243
.M9
M668
2003
v.1

FINAL
STATEWIDE OIL & GAS ENVIRONMENTAL IMPACT STATEMENT AND PROPOSED AMENDMENT OF THE POWDER RIVER AND BILLINGS RESOURCE MANAGEMENT PLANS

U.S. Department of the Interior
and
State of Montana

December 23, 2002

Recommended by: Sandra S. Brooks
Sandra S. Brooks, Billings Field Manager

Recommended by: David McIlnay
David McIlnay, Miles City Field Manager

Recommended by: Jan P Sensibaugh
Jan P. Sensibaugh, Director, MT DEQ

Recommended by:
Thomas P. Richmond, Administrator, MBOGC

Approved by: Dave Ballard
Dave Ballard, Chairman, MBOGC

Approved by: T. P. Lonnie
Thomas P. Lonnie, Acting State Director, Montana BLM

Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans

Lead Agencies: U.S. Department of the Interior, Bureau of Land Management (BLM); and the State of Montana, Board of Oil and Gas Conservation and Department of Environmental Quality.

Type of Action: Administrative

Jurisdiction by Agency (Planning Area):

- *State of Montana:* Statewide.
- *BLM:* Powder River RMP Area—Powder River, Carter, and Treasure counties and portions of Big Horn, Custer and Rosebud counties. Billings RMP Area—Carbon, Golden Valley, Musselshell, Stillwater, Sweet Grass, Wheatland, and Yellowstone counties and the remaining portion of Big Horn County. The planning area for the BLM contains 1,506,011 acres of federally managed surface, and 5,009,784 acres of federal mineral estate.

Abstract: The BLM and the State of Montana analyzed alternative approaches for managing oil and gas resources in this Final Environmental Impact Statement (EIS). As required by the National Environmental Policy Act (NEPA), the EIS is intended to "provide full and fair discussion of significant environmental impacts, and shall inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment" (43 Federal Register 55994, Section 1502.1).

Alternative E is the Preferred Alternative. This alternative would amend the Resource Management Plans and allow coal bed methane (CBM) exploration and development while minimizing impacts on environmental resources. The Preferred Alternative, as described in this Final EIS, provides a comprehensive framework for managing oil and gas resources on these public lands.

Four other alternatives were analyzed to evaluate different CBM exploration and production scenarios. Alternative A, the No Action Alternative, would continue existing management. Alternative B would allow CBM development while emphasizing protection of soil, water, air, vegetation, wildlife, and cultural resources. Alternative C would emphasize CBM development with minimal environmental restrictions. Alternative D would encourage CBM exploration and development while maintaining existing land uses.

All five alternatives are discussed in detail in Chapter 2. Chapter 3 presents the existing environment that would be affected by oil and gas development. Chapter 4 describes the impacts from each of the alternatives in terms of their impacts on the following resources:

- *Physical Resources:* Air Quality, Geology and Minerals, Hydrology, Soils, Solid and Hazardous Wastes, Vegetation, Visual Resources, Wilderness Study Areas, and Wildlife and Aquatics
- *Tribal, Historical, and Cultural Resources:* Cultural, Indian Trust Assets, and Paleontology
- *Human Resources:* Lands and Realty, Livestock Grazing, Recreation, and Social and Economic Resources

Further information regarding this Final EIS is available from the contact below or at the BLM website (http://www.mt.blm.gov). The BLM intends to issue a Record of Decision no sooner than 30-days after the Notice of Availability for this EIS published in the *Federal Register*.

Bureau of Land Management
Miles City Field Office
111 Garryowen Road
Miles City, MT 59301
Telephone: (406) 233-3649

SUMMARY

Introduction

The Bureau of Land Management (BLM) and the Montana Department of Environmental Quality (MDEQ), and Montana Board of Oil and Gas Conservation (MBOGC), (State) as joint lead agencies, have prepared the Statewide Oil and Gas Final Environmental Impact Statement (FEIS) and Amendment of the Powder River and Billings Resource Management Plans (RMPs). This FEIS focuses on the potential impacts of coal bed methane (CBM) exploration and production in 16 counties of south-central and southeastern Montana. The effects of anticipated conventional oil and gas development is also analyzed.

This summary discusses the following information:

- The planning area analyzed in the FEIS.
- The federal and state agencies responsible for preparing the FEIS.
- A brief explanation of what CBM is and why it occurs in coal beds.
- A summary of the purpose of and need for the FEIS.
- An explanation of how the FEIS conforms with the Powder River and Billings RMPs.
- A description of the environmental issues discussed in Chapters 3, 4, and 5 of the FEIS.

The Planning Area

The Powder River and Billings RMP Areas, located in south-central and southeastern Montana, constitute the BLM planning area or analysis areas for this FEIS. See the location map on the next page.

The State of Montana planning area is statewide, with an emphasis on the BLM planning area plus Blaine, Gallatin, and Park counties.

Preparers of the FEIS

The BLM and the State are the joint lead agencies responsible for preparing this FEIS. As lead agencies, BLM and the State are responsible for compliance with the National Environmental Policy Act (NEPA) of 1969 and Montana Environmental Policy Act (MEPA), respectively.

The information and proposed decisions discussed in the plan are not final until the BLM and the State sign separate Records of Decision (RODs). The ROD for BLM is signed no sooner than 30 days after the FEIS is published. The BLM will take any protests into account before signing the ROD.

The following agencies and tribes assisted the BLM and the State in the preparation of this FEIS:

- U.S. Environmental Protection Agency (EPA)
- Department of Energy (DOE)
- Bureau of Indian Affairs (BIA)
- Crow Tribe of Indians

As designated Cooperating Agencies, the EPA, DOE, BIA, and the Crow Tribe of Indians assisted the BLM throughout the FEIS analysis. The Northern Cheyenne Tribe, while not a formal cooperating agency, has also assisted the BLM and the State with preparation of the FEIS.

The cooperators' assistance included the submission of technical information and frequent consultation meetings with the BLM and the State to discuss issues and concerns along with possible mitigation measures. The cooperators may use or reference the FEIS for their future actions.

Coal Bed Methane

CBM is a natural hydrocarbon gas, primarily methane (CH_4), that occurs in beds of coal. Coal beds developed when dead plant material collected in ancient swamps and bogs. Once preserved and covered by soil and rocks, the plant material began to decay and to lose water, becoming more compact and dense, and its temperature began to increase. Over thousands of years, these natural processes ultimately produced various types of coal. Methane is usually found in sub-bituminous and bituminous coals.

What does the Summary Include?

The sections in this summary are the same as the five major chapters within the Final Environmental Impact Statement (FEIS). In most cases, second-level headings in the summary cover the same information as the same headings in the FEIS. Readers of this summary with questions should go to the parallel chapter or section in the FEIS.

CBM exploratory wells are drilled in an attempt to find viable commercial quantities of trapped methane. If the CBM exploratory wells are successful, additional wells are drilled to produce the methane by bringing it to the surface where it is processed and transported through pipelines to markets. Currently, the only methane production in Montana is from approximately 250 wells at the CX Field near Decker, Montana.

Chapter 1: Purpose and Need

The purpose of the EIS for both the BLM and the State of Montana is to analyze potential impacts from projected oil and gas activities, particularly from CBM exploration, production, development, and reclamation activities. The analysis is presented in 5 different alternatives which include different options for the management of CBM activities while protecting other resources and land uses. For BLM, the EIS analyses projected activities in the Billings and Powder River RMP areas, and for the State, the EIS analyses projected CBM activities statewide, emphasizing 16 counties with the greatest potential for CBM development.

This EIS is being used to analyze options for BLM to change its planning decisions by considering oil and gas management options including mitigating measures that will help minimize the environmental and social impacts related to CBM activities. The alternatives presented provide a range of management options for amending the RMPs. The preferred alternative (Alternative E) is BLM's proposed RMP amendment. The EIS will focus the analysis on the oil and gas development issues not covered in the current RMPs, such as water management from CBM production.

An analysis of CBM activities is needed for the State to supplement the State of Montana Oil and Gas Drilling and Production EIS and to provide the foundation for establishing CBM permitting guidance. The EIS also responds to the Stipulation and Settlement Agreement, dated June 19, 2000, between the Montana Board of Oil and Gas Conservation and the plaintiff, Northern Plains Resource Council.

Conformance with BLM Land Use Plans

This FEIS considers alternatives that would amend the two BLM RMPs:

- The Billings RMP issued by BLM on September 28, 1984, and subsequently amended to consider oil and gas development in 1994
- The Powder River RMP issued by the BLM on March 15, 1985, and subsequently amended for oil and gas in 1994
- The 1994 amendment to the RMPs analyzed oil and gas leasing operations and management actions on BLM administered lands.

Consultation

As part of the scoping effort, BLM and the State consulted with the U.S. Fish and Wildlife Service (FWS), regarding analysis in the FEIS and compliance with the Endangered Species Act.

In addition to the lead agencies, a number of state departments were consulted, including the Montana Bureau of Mines and Geology (MBMG), the Montana Department of Fish, Wildlife, and Parks (MFWP), the Montana Natural Resources and Conservation (DNRC), and the Montana State Historic Preservation Office (MSHPO).

Finally, consultation included meetings with the two Native American tribes with land in the planning area: the Crow Tribe of Indians and the Northern Cheyenne Tribe. Also the Lower Brule Sioux Tribe has areas of historic use within the planning area. The BLM has met with the Tribe to discuss their concerns about CBM development.

Issues Developed During Scoping

The BLM and the State identified a number of resource issues to be analyzed in the EIS. The list of issues was expanded as a result of comments received from the public during the scoping period. The issues are briefly described in the following paragraphs.

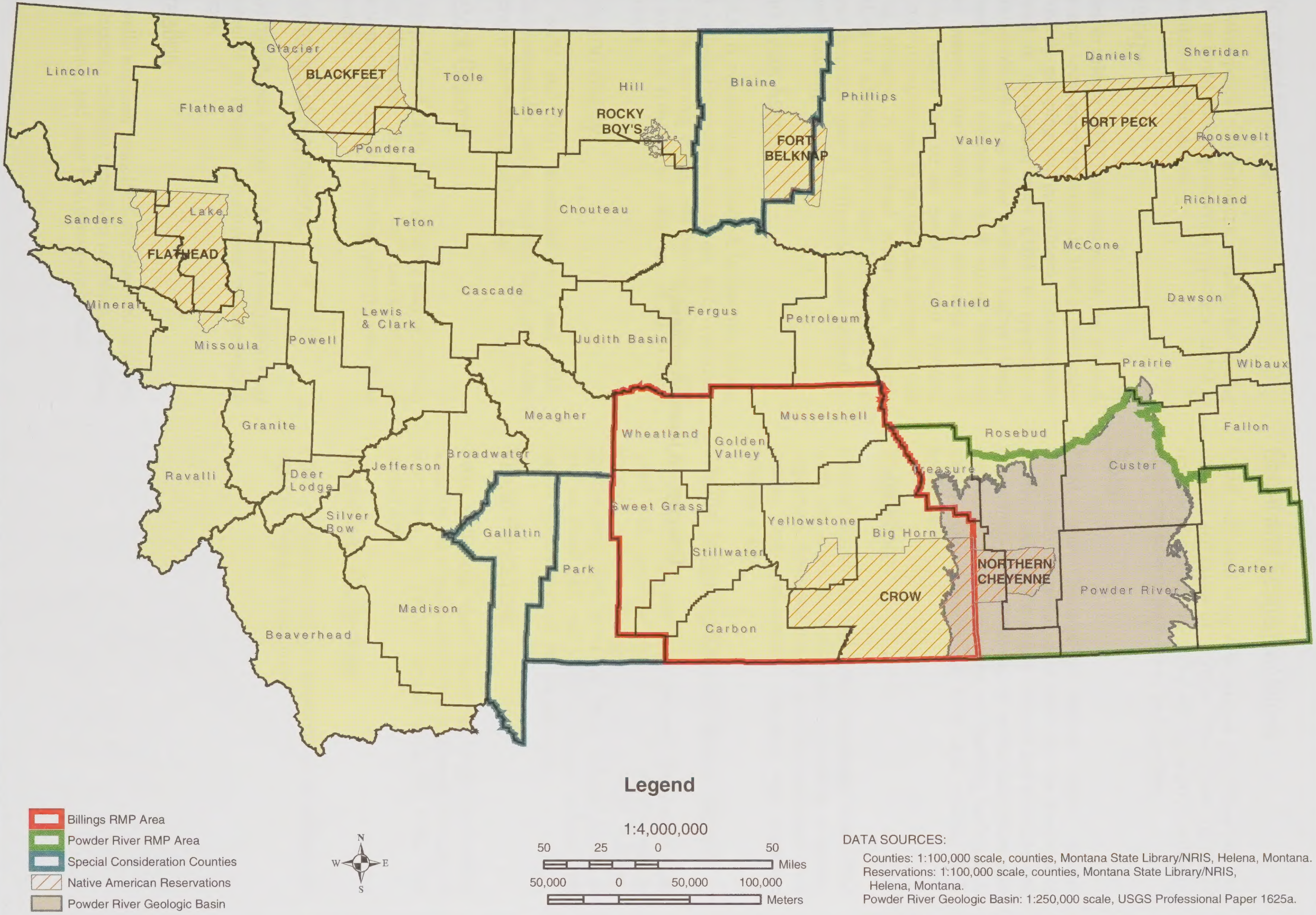
Air Quality and Climate

CBM wells and their associated pumps and other equipment could affect air quality both locally and region-wide.

Cultural Resources

CBM development activities and associated ground disturbance could inadvertently impact undiscovered cultural resource sites.

Map S-1: Planning Areas


Lincoln
Glacier
BLACKFEET
Toole
Hill
Blaine
Phillips
Daniels
Sheridan
Flathead
Liberty
ROCKY BOY'S
FORT BELKNAP
Valley
FORT PECK
Roosevelt
Pondera
Chouteau
Richland
Sanders
Lake
Teton
McCone
FLATHEAD
Cascade
Fergus
Petroleum
Garfield
Dawson
Mineral
Lewis & Clark
Missoula
Powell
Judith Basin
Prairie
Wibaux
Meagher
Musselshell
Wheatland
Golden Valley
Rosebud
Fallon
Granite
Broadwater
Ravalli
Deer Lodge
Jefferson
Treasure
Custer
Sweet Grass
Silver Bow
Gallatin
Yellowstone
Big Horn
Stillwater
Park
NORTHERN CHEYENNE
Carter
CROW
Powder River
Madison
Carbon
Beaverhead
Legend
🟥 Billings RMP Area
🟩 Powder River RMP Area
🟦 Special Consideration Counties
▨ Native American Reservations
▩ Powder River Geologic Basin
N
W
E
S
1:4,000,000
50
25
0
50
Miles
50,000
0
50,000
100,000
Meters

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Powder River Geologic Basin: 1:250,000 scale, USGS Professional Paper 1625a.

This page left blank intentionally.

Geology and Minerals

CBM development may influence or delay the mining of coal, or could change production priorities related to the production of oil and gas.

Hydrology

In order to release CBM from coal seams, the pressure in the coal seam must be reduced. This is practically achieved by pumping out groundwater. Groundwater produced in association with CBM is typically a sodium-bicarbonate type water having a higher salinity and more sodium relative to other cations than local surface waters. The storage and treatment of such produced waters can be an environmental problem, especially if waters are to be released untreated into existing streams. If produced waters are properly treated, or of suitable quality, they can be a beneficial resource for such uses as irrigation, dust control, or livestock watering.

Indian Trust Assets

The BLM is mandated to protect all Indian trust assets, which include Reservation water, air, soil, vegetation, water rights, hunting rights, and mineral rights. CBM wells have the potential to affect any or all of these trust assets.

Lands and Realty

CBM wells and their associated road and utility corridors potentially impact existing land use, either changing or decreasing possible uses.

Livestock Grazing

Land for proposed CBM wells often are part of existing grazing allotments. As such, well construction and production could change grazing patterns on these allotments.

Paleontological Resources

Ground disturbance during CBM well construction has the potential to impact undiscovered paleontological resources.

Recreation

CBM wells and their associated development activities could decrease existing recreation activities, including hunting, hiking, and other backcountry activities.

Social and Economic Values

CBM wells will bring new sources of revenue into the counties and towns of Montana. These new sources of revenue also affect the social and economic conditions of the residents in these towns and counties.

Soils

CBM wells necessarily include some ground disturbance. Disturbance of soils has the potential to increase sediment in nearby streams and to reduce soil productivity. The discharge of production water also has the potential, depending on handling methods, to change the chemistry of soils and reduce their productivity.

Vegetation

Ground disturbance and water discharges from CBM wells can affect the health and productivity of nearby vegetation. Increased human activities associated with drilling and maintenance practices can introduce noxious weeds.

Wildlife, Including Special Status Species

CBM well development has the potential to affect both listed and non-listed species. Such effects include impacts both on the species and on their habitats. Special status species include listed fish and plants, as well as listed bird and wildlife species, such as bald eagles, grizzly bears, or the Canada lynx.

Visual Resources

CBM wells and their associated roads and utility corridors are visually noticeable to anyone choosing to hike, hunt, or use the natural resources within the project area.

Wilderness Study Area

CBM exploration and development could potentially impact wilderness study areas.

Chapter 2: Alternatives

The FEIS presents five alternatives that describe and analyze different actions regarding the management of CBM activities. The No Action Alternative describes and analyzes current management of CBM activities by BLM and the State while the other four alternatives describe and analyze other management actions that provide different methods of protection to other resources and land uses from CBM activities. The five alternatives analyzed in detail are summarized in Table S-1.

Alternatives Considered

The alternatives analyzed in detail are summarized in Table S-1, and are described briefly below.

Alternative A—No Action (Existing CBM Management)

BLM would continue to review and approve APDs for conventional oil and gas and for CBM wells in accordance with the 1994 Oil and Gas Amendment.

Approved APDs would include only CBM exploration wells, not production wells. The State would conduct its permitting process by complying with the Stipulation and Settlement Agreement dated June 19, 2000. Under this agreement, the State can approve up to a maximum of 325 producing wells in the CX Field and 200 exploratory CBM wells throughout the rest of the state.

Alternative B—CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

BLM and the State would review and approve CBM activities with an emphasis on resource protection. BLM and the State would use stringent mitigation measures to minimize or eliminate adverse impacts to other resources. Examples of such mitigation measures would include requiring the injection of water produced with CBM and requiring all compressors to be fueled by natural gas rather than by diesel or electricity.

Alternative C—Emphasize CBM Development

BLM and the State would review and approve CBM activities with an emphasis on facilitating production of CBM. BLM and the State would use the least restrictive mitigation measures to minimize or eliminate adverse impacts to other resources. Examples of such measures would be to authorize the discharge of water produced with CBM onto the ground or into the water bodies when the discharge water meets applicable standards. Compressors could be fueled by gas, diesel, electricity, or other means as long as other permitting standards, such as air quality, are met.

Alternative D—Encourage CBM Exploration and Development While Maintaining Existing Land Uses

BLM and the State would review and approve CBM activities with an emphasis on maintaining or enhancing land uses in combination with CBM development. BLM and the State would use mitigation measures, as much as possible, that compliment the needs of land owners and other lessees. Management of water produced with CBM would be greatly influenced by the surface owner. The water could be made available for beneficial uses or may be required to be reinjected. Location of facilities, such as compressors, would be influenced by the needs of the land owner.

Alternative E—Preferred CBM Development Alternative

BLM and the State would review and approve CBM activities in a manner that facilitates efficient and orderly CBM activities while providing the appropriate type of resource protection on a site specific basis as well as an ecosystem basis. Different management actions, such as discharge, impoundment, reinjection or beneficial use, would be applied to water produced with CBM. Likewise, different management actions such as location, size, and mufflers (as required) would be applied to compressors. Also, realty questions, such as the handling of surface disturbance, would be handled by requiring the operator to consult with the owner of the surface rights.

Comparison of Impacts

Table S-2, provided at the end of this Summary, is the same as Table 2-3 in the FEIS. Table S-2 summarizes and compares the impacts of the alternatives.

TABLE S-1
ALTERNATIVE MANAGEMENT FOR CBM

Issue Topic	Management Action	Alternative A—No Action (Existing CBM Management)	Alternative B—CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred CBM Development Alternative
Air	Maximize the number of wells connected to each compressor	No	Yes	No	Yes	Yes
	Type of fuel to power compressors	Diesel, electric, or gas-fired	Gas-fired	Diesel, electric, or gas-fired	Gas-fired with electric boosters	Gas-fired or electric boosters
	Noise suppression required	No	No	No	No	Yes
	Implementation of a speed limit on CBM roads on BLM	No	Yes	No	Yes	Yes
	Air permit analysis	Yes	Yes	Yes	Yes	Yes
Coal Mines	Buffer zone (1 mile) around active coal mines	No	Yes	No	Yes	No
Coal Bed Methane	APD to be filed and approved prior to drilling	Yes	Yes	Yes	Yes	Yes
	CBM exploration limits	Yes	No	No	No	No
	CBM production limits	Yes	No	No	No	No
	Project Plan of Development required in consultation with tribes, surface owners, and other agencies	No	No	No	No	Yes
	Directional drilling required	No	Yes	No	Yes	Yes, unless exempted
	Multiple coal seams developed per well bore required	No	Yes	No	Yes	No

TABLE S-1
ALTERNATIVE MANAGEMENT FOR CBM

Issue Topic	Management Action	Alternative A— No Action (Existing CBM Management)	Alternative B— CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources	Alternative C— Emphasize CBM Development	Alternative D— Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E— Preferred CBM Development Alternative
Coal Bed Methane, 'cont.	Simultaneous coal seam development required	No	Yes	No	Yes	No
	Wellhead camouflage required by BLM	No	No	No	Yes	Yes
Hydrology	Exploration water disposal	Untreated and stored, except for CX Ranch	Untreated and stored	Untreated surface discharge	Treated and conveyed	Exploration Water Management Plan required
	Production water disposal	CX Ranch only	Injection	Untreated surface discharge	Treated and conveyed	Various Methods Water Management Plan Required
	Site-specific Water Management Plan required	Yes	No	No	No	Yes
	Exploration/production water available for beneficial use	Yes	No	Yes	Yes	Yes
Realty	Corridors required	No	Yes	No	Yes	No, with surface owner consultation
	Powerline placement	Aboveground or buried	Buried	Aboveground or buried	Buried	Aboveground or buried
	Abandoned access roads	Agency/Surface Owner Discretion	Agency/Surface Owner Discretion	Agency/Surface Owner Discretion	Agency/Surface Owner Discretion	Agency/Surface Owner Discretion
	High fire danger restrictions	No	Yes	No	Yes	Yes
	Road use enforcement on BLM	No	Yes	No	Yes	No

TABLE S-1

ALTERNATIVE MANAGEMENT FOR CBM

Issue Topic	Management Action	Alternative A— No Action (Existing CBM Management)	Alternative B— CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources	Alternative C— Emphasize CBM Development	Alternative D— Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E— Preferred CBM Development Alternative
Realty, 'cont.	Road placement on boundaries on BLM	No	Yes	No	No	Yes
Indian Trust and Native American Concerns	Buffer zone (2 miles) around reservations	No	Yes	No	Yes	No
	Monitoring wells required on BLM-administered minerals that abut reservations	No	No	No	No	Yes
	Resource protection protocols	No	No	No	No	Yes
	Air quality mitigation measures	No	No	No	No	Yes
	Special cultural resources protection measures	No	No	No	No	Yes
Vegetation	Commercially harvest ROW trees on BLM	No	Yes	No	No	Agency or Surface Owner Discretion
	Revegetate with early successional and late seral stage plants on BLM	Agency or Surface Owner Discretion	Agency or Surface Owner Discretion	Agency or Surface Owner Discretion	Agency or Surface Owner Discretion	Agency or Surface Owner Discretion
	Noxious weed control by operator	Yes	Yes	No	Yes	Yes

TABLE S-1

ALTERNATIVE MANAGEMENT FOR CBM

Issue Topic	Management Action	Alternative A—No Action (Existing CBM Management)	Alternative B—CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred CBM Development Alternative
Wildlife	Wildlife surveys required by BLM	Yes	Yes	Yes	Yes	Yes
	Gray wolf, Canada lynx and grizzly bear surveys by BLM	As needed	As needed	As needed	As needed	Yes
	FWS biological opinion mitigation measures on BLM	No	Yes	Yes	Yes	Yes

This comparison of impacts defines the resource issues and to distinguishes between the alternatives. See the text in the Environmental Consequences section below for additional highlights of the environmental impacts.

Chapter 3: Affected Environment

This chapter in the FEIS does not present impacts. It describes what is currently present or happening within the counties being analyzed.

The affected environment includes the physical, biological, social, and economic resources that the alternatives could impact. For the BLM, these resources are in two resource planning areas located in south-central and southeastern Montana. For the state, the analysis area includes all Montana counties, not just the 16 counties covered in the emphasis area analysis. Despite this statewide analysis area, the resource information in Chapter 3 of the FEIS focuses on conditions within the core 16 counties.

Several federally recognized Indian tribes own land within the emphasis area analyzed in the FEIS. These tribal governments include the Crow Tribe of Indians, the Northern Cheyenne Tribe, The Lower Brule Sioux Tribe, the North Dakota Turtle Mountain Tribe, and the Fort Belknap Indian Community (Gros Ventre and the Assiniboine). Their land holdings are an important share of the planning area:

- The Crow Reservation comprises nearly 2,296,000 acres in south-central Montana.
- The Northern Cheyenne Reservation comprises about 445,000 acres in southeastern Montana, and lies just east of the Crow Reservation.
- The North Dakota Turtle Mountain Tribe has approximately 61,250 acres of federal trust lands allotted to their members, which are scattered throughout the emphasis area.
- The Fort Belknap Indian Reservation comprises about 623,000 acres and lies in north-central Montana.
- The Lower Brule Sioux Tribe has also contacted BLM about the allotted lands held in trust by the federal government in the emphasis area, along with numerous traditional cultural sites.

These Native American land holdings share many of the same resource values as those summarized below for the entire state of Montana.

Resources in the emphasis area are described in the FEIS based on the scope and intensity of the potential impacts. The following bullet points highlight the existing resource conditions. For more information about the resources in the study area, see Chapter 3 in the FEIS.

- Air quality is generally very good, based on few industrial emission sources and on scattered residences in small communities and isolated ranches.
- The area is rich in cultural resources, especially historic sites, including fur trading posts, homesteads, emigrant and stage trails, Indian war battle sites, ranch centers, and many Native American sites (the use of which continued well into the historic period).
- Minerals include uranium, gold, silver, gypsum, vanadium, and bentonite. Oil and gas resources are scattered across the analysis area. Extensive coal beds are an especially important resource in south-central and southeastern Montana.
- Surface water is the primary water source for Montana users. The quality of surface water is generally good to fair, but some problems with salinity occur during periods of low flow. Groundwater is a minor source of usable water, however in some areas groundwater is the only source of water for domestic stock use. Groundwater quality is sometimes a problem, often making it unsuitable for irrigation, however it typically meets standards for domestic and stock use.
- Indian trust assets include lands, timber, water resources, other natural resources, and assets held in trust by the U.S. government for Indian tribes and individual Indians.
- Livestock grazing is an important economic activity. The planning area includes some 1,205 federal grazing allotments, covering about 1.6 million acres of federal land.
- Recreation is an increasingly important feature of the Montana economy. Large areas of federal and state land are dedicated to recreation, including land for fishing, hunting, hiking, photography, wildlife viewing, water sports, off-road vehicle activities, camping, touring, and caving.
- Population within the 16-county emphasis area is increasing at an average annual rate of 1.2 percent. Socio-economic data from the 2000 census shows a total population of about 286,000 people in the

emphasis area. These residents, along with the many thousands who annually visit and use Montana resources, are important contributors to the overall health of the Montana economy.

- Socio-economic data includes the per capita income figure for the emphasis area: $17,715. The statewide per capita figure was $21,229, while the total U.S. figure was $27,203. Per capita income has been increasing in the emphasis area at roughly a 5.0 percent annual rate.

- Vegetation varies within a wide range of plant communities: grasslands, shrublands, forests, and riparian areas.

- Visual resources in the analysis area are diverse and of high importance, both to residents and to the many visitors to Montana.

- Wildlife include mammals such as elk, mule deer, white-tailed deer, and pronghorn; bird species, including waterfowl, raptors, and songbirds (many of which are neotropical migrants); reptiles and amphibians; and many species are either listed for protection or are of special management concern, including sage grouse, mountain plover, prairie dogs, gray wolf, Canada lynx, and the grizzly bear.

Chapter 4: Environmental Consequences

This chapter of the FEIS presents the scientific and analytical information that supports conclusions about the potential impacts of the alternatives analyzed. This information is then summarized in a comparative form in Table 2-3 (provided at the end of this Summary as Table S-2).

The resource impacts summarized in this section focus on the most important impacts of Alternative E—Preferred CBM Development Alternative. Alternative E is the one that the BLM and the State currently consider to be “preferred” (that is, the alternative that the BLM and Montana will likely select in their respective RODs following issuance of the FEIS).

Resources with Low Intensity Impacts

As shown in Table S-2, potential impacts on some resources are of low intensity and do not change much, if at all, among alternatives. Impacts of this sort do not help readers distinguish between alternatives. This similarity among alternatives occurs because the alternatives are programmatic in nature. Programmatic alternatives do not and cannot reflect actual conditions at specific sites. The APD process is used to verify that the BLM and the State have considered actual site conditions before issuing an APD. Resources with low intensity and similar impacts include the following:

- Cultural Resources
- Environmental Justice
- Geology and Minerals
- Livestock Grazing
- Paleontological Resources
- Solid and Hazardous Wastes
- Wilderness Study Areas

Resource Impacts that are Important Features of Alternative E

The following sections highlight those impacts that would help readers understand the context and intensity of the actions included in Alternative E. For more information about these impacts, see the full text of Chapter 4 in the FEIS.

Air Quality

Alternative E project emissions would not alone cause a potential violation of National or Montana Ambient Air Quality Standards (NAAQS/MAAQS) or Prevention of Significant Determination (PSD) Class I/Class II Increments. However, impacts on visibility at several (15) Class I and Class II areas, including the Northern Cheyenne, Crow, and Fort Belknap Indian Reservations, have been predicted through modeling.

Although the air quality modeling shows the potential for exceedances of certain standards, these impacts would not occur. The air quality permitting process would be used to analyze emission sources at the project level for CBM development. Emission sources that would violate standards would not be permitted by the agencies. Thus, the residual impacts to air quality would remain within standards.

Hydrological Resources

Surface Water

Surface water quality would be slightly altered from current water quality conditions, which are generally good. Downstream uses would not be diminished. Surface water flows moderately increase from existing flows, causing some minimal riparian erosion.

Groundwater

Groundwater drawdown of more than 20 feet is anticipated to extend 4 to 5 miles from the edge of production. However, this value may vary, depending on the intensity of CBM development and site-specific conditions. Minor impacts on shallow groundwater quality could occur, due to some infiltration from impoundments and from on-surface recharge of production water.

Beneficial Reuse

The required use of Water Management Plans would increase beneficial reuse of production waters (more than 20 percent of the production water from a given well).

Indian Trust Assets

Impacts on Indian trust assets would be mitigated, as with the preceding discussion of surface water, groundwater, and beneficial reuse management requirements. With regards to Tribal CBM resources, mitigation and monitoring measures would protect the resources of the Tribes. Wildlife monitoring and protection measures would be employed to prevent the loss of important hunting, fishing, and plant gathering locations.

Lands and Realty

Impacts would result from ground disturbance associated with roads, utility corridors, and CBM drill pads. The land disturbed by CBM activities could range from approximately 44,000 acres (long-term) to as many as 74,000 acres (short-term). These acreages are less than 1 percent of the 16 county emphasis area analyzed (approximately 25 million acres in the 16 counties).

Recreation

Adverse impacts from roads, utility corridors, and well pads would be balanced by the increased road access. The overall impacts of Alternative E would be limited in intensity and would vary greatly from site to site.

Social and Economic Values

Exploratory and production wells could result in some new employment opportunities and some associated increases in population, but the overall percentage increase would be less than 1 percent. These impacts would be economically beneficial, but the social impacts could be either beneficial or adverse.

Soils

Disturbance to soils would be minor, based on the estimate that only 44,000 acres (long-term) would be disturbed by CBM activities. Changes in soil chemistry would also be minimal, based on the control of production water discharges and water quality protection measures.

Vegetation

Alternative E would potentially disturb nearly 74,000 acres in the initial short-term period. Of this, approximately 66,500 acres would be native vegetation consisting of 29,000 acres of grassland, 18,000 acres of shrubland, 16,000 acres of forest land, and 3,500 acres of barren land. Noxious weed controls would be employed to control the potential spread of these unwanted species. This disturbance is less than 1 percent of the acreage in the emphasis area.

Visual Quality

Visual impacts would be moderate in nature and, in some cases, permanent. For example, power line access corridors are likely to be permanent and highly visible. Required management actions (mitigations) would lessen the impacts on visual quality by employing camouflage techniques and limiting development on certain visual resource classified areas.

Wildlife

Direct impacts on wildlife would include habitat loss, death from collisions with vehicles, and disturbance from human access.

The impacts on special status species have been summarized in the FWS letter received September 4, 2002. A portion of the letter is summarized below:

> "We concur with your determinations that the proposed action is likely to adversely affect the threatened bald eagle, and the proposed mountain plover. Although the BLM has determined that implementation of proposed changes in coal bed methane is likely to affect the black-tailed prairie dog *(Cynomys ludovicianus)*, we concur with your determination that the action is not likely to adversely affect the black-footed ferret (*Mustela nigripes*).
>
> "This concurrence is based upon the BLM's commitments to 1) locate project activity to avoid impacts to prairie dog colonies that meet FWS criteria as black-footed ferret habitat

> (FWS 1989), 2) conduct ferret surveys in suitable habitat, following current lease stipulations for oil and gas development, and 3) if a black-footed ferret or its sign is found during a survey, all development activity would be subject to recommendations from the *Montana Black-footed Ferret Survey Guidelines, Draft Managing Oil and Gas Activities in Prairie Dog Ecosystems with Potential for Black-footed ferret Reintroduction* and re-initiation of Section 7 Consultation with the Service.
>
> "The Service also concurs with your determination that the action is not likely to adversely affect the threatened Ute ladies'-tresses orchid (*Spiranthes diluvialis*), the pallid sturgeon *(Scaphirhynchus albus)*, and the Montana arctic grayling *(Thymallus arcticus)*. The Service gives its concurrence to BLM's determination of "no effect" for the Canada lynx *(Lynx canadensis)*, gray wolf *(Canis lupus)*, interior least tern *(Sterna antillarum athalassos)*, and the warm spring zaitzevian riffle beetle *(Zaitzevia thermae)*." (FWS 2002.)

A copy of the letter is included in the Wildlife Appendix of the FEIS.

Chapter 5: Consultation and Coordination

The BLM and the State conducted extensive consultation and coordination and provided opportunities for public comment during FEIS preparation. Public comment periods are intended to provide interested and concerned individuals opportunities to express their concerns and issues related to decisions the BLM and the State should make.

NEPA scoping and consultation included federal agencies, state departments, and Native American tribes. Key steps and dates in the consultation and coordination were as follows:

- The BLM published a Notice of Intent in the *Federal Register*, informing the public and other agencies that the EIS process is beginning (December 19, 2000).
- The BLM and the State held joint scoping meetings and circulated written requests for information and questions (January and February 2001).
- The BLM and the State met with FWS and with other federal agencies, including the agencies that are official cooperators in the EIS process. The BLM and the State also met with the Crow Tribe of Indians, and the Northern Cheyenne Tribe throughout 2001.
- The BLM and the State issued the Draft EIS (DEIS) and solicited comments on the DEIS (February – May 2002).
- The BLM and State held six public hearings throughout the emphasis area to collect public comments.
- Some 18,000 comments on the DEIS were submitted; approximately 8,800 of these comments directly addressed the BLM and Montana actions affecting CBM exploration and development (February through May 2002).
- BLM and the State of Montana issue the FEIS, incorporating revisions and responses to agency, Native American, and public comments (January 2003).

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Air Quality *Existing air quality throughout most of the analysis area is in attainment with all ambient air quality standards. However, three areas have been designated as federal nonattainment areas where the applicable standards have been violated in the past: Lame Deer (PM_{10}—moderate) and Laurel (SO_2—primary), Montana; and Sheridan, Wyoming (PM_{10}—moderate).*					
	• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.	• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.	• Impacts under Alternative C are expected to be comparable to those describe for Alternative B but somewhat increased in severity due to the lack of control over operators choose for compressor fuel, reduced limits on compressor hook ups and the lack of enforceable control measures.	• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.	• Impacts modeled for Alternative E would be comparable to those describe for Alternative B but are somewhat decreased in severity due to the use of gas-fired compressors and maximized compressor hook ups.
	• Maximum concentrations are expected to be below applicable state and National Ambient Air Quality Standards and PSD increments for near-field and far-field modeling.	• Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.		• Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.	• Although the air quality modeling shows the potential for certain standards to be exceeded, these impacts would not occur. The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies and therefore, residual impacts would remain within standards.
	• Potential direct impact on visibility within one mandatory federal PSD Class I, one Class II Area and the Class II Crow IR.	• Potential direct visibility impacts within seven mandatory federal PSD Class I Areas and the Northern Cheyenne Reservation. Additional visibility impacts to seven federal PSD Class II areas including the Crow and Fort Belknap Indian Reservations and three Wilderness Areas and one National Recreation Area and one National Monument.		• Potential direct visibility impacts within one mandatory federal PSD Class I Areas. Additional visibility impacts to three PSD Class II areas including the Crow Indian Reservation, one Wilderness Area and one National Recreation Area.	
	• Cumulative Impacts: – Potentially exceed the 24-hour PM_{10} NAAQS and PSD Class II increments south of Spring Creek Mine. – Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation. – Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area.	• Cumulative Impacts: – Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine. – Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine. – Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and at Washakie. – Potentially exceed PSD Class I increments for annual NO_2 on the Northern Cheyenne Reservation.	• Cumulative Impacts: – Same as Alternative B.	• Cumulative Impacts: – Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine. – Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine. – Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA.	• Cumulative Impacts: – Same as Alternative B.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Air Quality (cont'd.)	– Potential visibility impacts in 10 of 17 federal PSD Class I including the Crow and Fort Peck Indian Reservations. Additional visibility impacts to 7 of 13 PSD Class II sensitive areas including the Crow and Fort Belknap Indian Reservations.	– Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and Florence Lake in the Class II Cloud Peak Wilderness Area. – Potential visibility impacts in all federal PSD Class I and II sensitive areas including the N. Cheyenne, Fort Peck, Fort Belknap and Crow Indian Reservations.		– Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area. – Potential visibility impacts in 14 of 17 federal PSD Class I and all Class II sensitive areas including the N. Cheyenne, Fort Peck, Fort Belknap and Crow Indian Reservations.	
Cultural Resources *Approximately 73,600 cultural resource sites exist above known coal resources within the CBM emphasis area*	• An estimated 17 cultural resource sites could be identified during foreseen CBM activities. Of these only one or two would likely be eligible for the NRHP. • Cumulative Impacts: – An estimated 4,285 cultural sites would be identified. resulting in 430 to 612 sites likely eligible for the NRHP. – Identification of TCPs would increase with the development of CBM.	• The number of cultural resource sites identified would be practically the same for Alternatives B, C, D, and E based on the level of development, associated area of disturbance and minor differences between the alternative realty management actions. An estimated 630 cultural resource sites would be identified, of these sites, 120 to 170 could be found eligible for the NRHP. • Cumulative Impacts: – An estimated 5,135 cultural sites could be identified resulting in 515 to 735 sites that could be eligible for the NRHP. – Identification of TCPs would increase with the development of CBM.			

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Environmental Justice *Executive Order 12898 requires the non-discriminatory treatment of minority and low-income populations for projects under the jurisdiction of a federal agency*					
	• No adverse impacts with the exception of the undetermined Wyoming discharge influence. It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.	• No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana river's would constitute a potential environmental justice issue if unresolved. No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.	• Same as B except for adverse environmental effects would be expected from downstream water quality changes resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.	• No adverse human health or environmental effects would be expected to fall. disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.	• No adverse human health or environmental effects would be expected to fall. disproportionately on minority or low-income populations from this alternative. • Impacts would be mitigated as described under the *Environmental Justice* section, *Alternative A* and by implementation of the Project Plan of Development requirements.
Geology and Minerals *Montana's mineral resources are intimately tied to the complex geologic framework of the state. Locatable minerals and conventional Oil and Gas resources are found throughout the planning area in various recoverable and non-recoverable amounts*					
	• Federal: – Only minor loss of CBM during testing operations.	• Federal: – Irretrievable commitment of CBM resources from production, magnitude and complexity to reflect increase scale of development. – Potential mineral drainage between Federal mineral estates and state, fee and Tribal developments depending on site-specific conditions. – The presence of shallow CBM production could delay or interfere with certain types of seismic prospecting for conventional oil and gas reservoirs.	• Federal: – Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.	• Federal: – Same as Alternative B.	• Federal: – Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone. – Protection of potential Tribal CBM from drainage because of resource protection protocols.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Geology and Minerals (cont'd.)					
	• State: – Irretrievable commitment of CBM resources from CX Ranch Field production. – Delayed development or expansion of conventional oil and gas, coal mining, and surface mineral mining in minor instances with no interruption to existing activities. – CBM production dewatering at nearby coal seams, in rare occurrences can cause underground coal fires, methane seeps, and the liberation of methane to water wells.	• State: – Increased commitment of CBM resources due to increased level of CBM. – Mineral drainage and seismic interference issues same as for Federal under this alternative.	• State: – Same as Alternative B. – Potential mineral drainage between federal mineral estates and state, fee, or Tribal developments depending on site-specific conditions.	• State: – Same as Alternative B. – Potential mineral drainage between Federal mineral estates and state, fee, or Tribal developments depending on site-specific conditions.	• State: – Same as Alternative B. – Potential mineral drainage between federal mineral estates and state, fee or Tribal developments depending on site-specific conditions.
	• Cumulative Impacts: – Reduction in Coal resources from current and planned surface mine operations. – Potential CBM drainage along Wyoming Montana State Line.	• Cumulative Impacts: Increase in wells and infrastructure could impact existing mine expansion greater possibility of CBM drainage than A.	• Cumulative Impacts: Impacts increased over alternative B.	• Cumulative Impacts: – Same as Alternative B.	• Cumulative Impacts: Similar to Alternative B. – Potential mineral drainage between federal mineral estates and state, fee, or Tribal developments depending on site-specific conditions.
Number of wells predicted for analysis purposes:	• Federal/State – up to 925 CBM and 1720 Conventional wells. • Cumulative – up to 925 CBM and 1775 Conventional wells.	• Federal/State – up to 18,275 CBM and 1720 Conventional wells. • Cumulative – up to 26,475 CBM and 1775 Conventional wells.	• Federal/State – up to 18,275 CBM and 1720 Conventional wells. • Cumulative – up to 26,475.CBM and 1775 Conventional wells.	• Federal/State – up to 18,275 CBM and 1720 Conventional wells. • Cumulative – up to 26,475 CBM and 1775 Conventional wells.	• Federal/State – up to 18,275 CBM and 1720 Conventional wells. • Cumulative – up to 26,475 CBM and 1775 Conventional wells.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Hydrological Resources *Surface water: The Tongue River has generally good quality water with a seasonal flow consistent from year to year and is frequently used for irrigation The Powder and Little Powder Rivers are characterized as having fair to poor quality water and can and do go dry, the waters are used for stock and limited irrigation.* *Groundwater: Regional groundwater is available in stream bottoms and alluvium, but becomes scarce away from the water course. Coal beds and interlayered sands are the most commonly used aquifers away from riparian areas. Groundwater quality is variable and effects taste and beneficial uses.* *Beneficial Reuse: The southeastern region of Montana is classified as a high plains desert environment and has experienced drought conditions for the past seven years*					
	• Federal: – No impacts to surface or groundwater resources. – No beneficial reuse. • State: – Negligible increase in surface water flow and quality changes in the Tongue River. No change in other waterways. – Groundwater drawdown within the immediate vicinity of the CX Ranch. – Continued beneficial reuse of produced water at the CX Ranch.	• Surface Water – Surface water quality and quantity changes should be the same as Alternative A due to injection control.	• Surface Water – Surface water quality in some watersheds would be noticeably altered, resulting in restricted downstream uses. – Surface water flow would be considerably increased in some watersheds causing persistent riparian erosion, changes in watercourses and increased sedimentation.	• Surface Water – Surface water quality would not be altered due to required treatment prior to discharge – Surface water flow would be similar to Alternative C but with slight increase in volume due to reduced conveyance loss.	• Surface Water – Surface water quality would be slightly altered, however downstream uses would not be diminished. – Surface water flow would be moderately increased causing some riparian erosion, as well as increased sedimentation.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Hydrological Resources (cont'd.)					
		• Groundwater: – Groundwater will be drawn down over time in the Powder River Basin. – Isolated areas of development would experience an increased drawdown effect. – Immediate drawdown of coal seam aquifers would be minor and limited in horizontal extent. As CBM. production matures, coal seam aquifer drawdown could exceed 20 feet and reach as far as 4 to 5 miles from the edge of production. – No change in groundwater quality.	• Groundwater: – Drawdown same as Alternative B. – Alluvial groundwater quality would be altered due to infiltration of untreated production water.	• Groundwater: – Drawdown same as Alternative B – No groundwater quality impacts.	• Groundwater: – Drawdown would be the same as Alternative B. – Minor impacts to shallow groundwater quality from impoundment infiltration and surface discharge of some untreated production water.
		• Beneficial Reuse: – Same as Alternative A.	• Beneficial Reuse: – Same as Alternative A.	• Beneficial Reuse: – Increased availability of treated water for a variety of downstream and increased beneficial uses, estimated at 20% of production.	• Beneficial Reuse: – Required Water Management Plans from all operators would result in increased beneficial reuse of production water, estimate at 20%.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Hydrological Resources (cont'd.)					
	• Cumulative Impacts: – Surface Water: Wyoming's discharge of CBM production water would increase surface water flow in Montana rivers depending on the season and watershed from minor to noticeable amounts. The surface water quality in the three-shared rivers between Montana and Wyoming would be slightly altered, however downstream uses will not be diminished. – Groundwater: Drawdown of groundwater from Wyoming CBM operations could extend several miles north into Montana. Groundwater quality in Montana would not be impacted by Wyoming CBM operations Drawdown from the CX Ranch may extent out several miles from the development.	• Cumulative Impacts: – Surface water flow and quality will be the same as Alternative A. – CBM production in Montana coupled to nearby Wyoming wells would noticeably increase the drawdown of groundwater aquifers.	• Cumulative Impacts: – Surface water quality in some watersheds would be noticeably altered, resulting in restricted downstream uses. – Surface water flow would be considerably increased in some watersheds causing persistent riparian erosion, changes in watercourses and increased sedimentation. – Impacts to groundwater drawdown, quality and beneficial reuse would be the same as in Alternative B.	• Cumulative Impacts: – Surface water quality would not be degraded and minor impacts from Wyoming would be diluted. – Surface water flow impacts would be similar to Alternative C with added volume due to reduced conveyance loss. – Impacts to groundwater drawdown and quality would be the same as in Alternative B. – Increased beneficial reuse, estimated at 20% of production.	• Cumulative Impacts: – Cumulative impacts would be dependent on WDEQ/MDEQ Water Quality Agreement and MDEQ non-degradation numerical standards. – Surface water quality would be slightly altered however downstream uses would not be diminished. – Surface water flows would be moderately increased in some watersheds and provide a source of flow in some rivers that would otherwise have gone dry seasonally. – Impacts to groundwater drawdown would be the same as Alternative B. – Shallow groundwater quality would be slightly altered due to impoundment infiltration and surface discharge of untreated production water. – Use of Water Management Plans and agency approval would result in increased beneficial reuse, estimated at 20%.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Hydrological Resources (cont'd.)					
	– Beneficial Reuse: Due to the increased water volumes from Wyoming's discharge there would be added opportunities for irrigation, stock watering and other uses from waterways, depending on the water quality.				
Indian Trust and Native American Concerns *Indian Trust Assets (ITAs) are official interests in assets held in trust by the federal government for Indian tribes or individuals. The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines ITAs as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians.*					
	• Federal: – No measurable impacts to Indian trust assets would occur from the CBM activities.	• Federal: – No surface water quality impacts foreseen. – Potential CBM drainage, dependent on specific site conditions, delayed by buffer zone. – Visibility impacts. – Wildlife Adaptation resulting in changes. – Potential cultural resource impacts to TCPs.	• Federal: – Potential for surface water quality and quantity impacts. – Potential CBM drainage, same as Alternative B. – Cultural Resource impacts same as B. – Visibility impacts.	• Federal: – Groundwater drawdown same as Alternative B. – Surface water quality impacts reduced by source treatment, increased availability of surface waters for irrigation and other beneficial uses. – Increased surface water flow could result in increase riparian erosion. – Potential CBM drainage, same as Alternative B. – Cultural Resource impacts same as B. – Visibility impacts.	• Federal: – Effects from groundwater drawdown mitigated because of resource protection protocols. Potential CBM drainage mitigated through the use of resource protection protocols. – Surface water quality impacts reduced with increased availability of surface waters for irrigation and other beneficial uses. – Increased surface water flow could increase riparian erosion. – Air Quality and visibility impacts alleviated through site specific permits and mitigation.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Indian Trust and Native American Concerns (cont'd.)					
	• State: – No measurable impacts to Indian trust assets would occur from the CBM activities.	• State: – Groundwater drawdown inward from reservation boundaries. – Limited short-term surface water impacts from spills and ruptures adjacent to Reservations. – Potential CBM drainage, dependent on specific site conditions, no delay due to adjacent development.	• State: – Groundwater drawdown same as Alternative B. – Surface water quality and quantity impacts. – Potential CBM drainage, same as Alternative B.	• State: – Groundwater drawdown same as Alternative B. – Surface water quality impacts reduced. – Potential CBM drainage, same as Alternative B.	• State: – Surface water quality protected.
	• Cumulative Impacts: – Reduction in Coal resources from the Absaloka Mine operation. – Surface water quality and quantity in the Tongue River would not be noticeable altered from Wyoming CBM development. – Drawdown of groundwater from Wyoming CBM operations has the potential to lower aquifer levels on the Crow Reservation. – Potential CBM drainage along southeastern corner of Crow Reservation from Wyoming operations.	• Cumulative Impacts: – Same as Alternative A. – Reduction of CBM resources if developed by Tribes, coupled with land disturbances and associated water impacts. – Changes in visibility. – Air Quality changes. – Potential air quality impacts to PSD class I 24-hour PM10 increments. – Potential air quality impacts to PSD Class I annual NO_2 increments.	• Cumulative Impacts: – Same as Alternative B.	• Cumulative Impacts: – Same as Alternative B except no potential air quality impacts to PSD Class I annual NO_2 increments.	• Cumulative Impacts: – Same as Alternative B.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Lands and Realty	*Emphasis Area Land Ownership: Private 65%, Federal 20%, Tribal 10%, State 5%* *Total Acreage: 25,551,308*		*Miles of Road: Interstate, 440; US; 845; State, 430; Off-System,13,550* *Miles of Railroad: BNSF, 420; MT Rail Link, 190*		
	• Federal: – Minimal land area displaced by roads. – 400 acres disturbed short term during CBM exploration drilling. • State: – Increased motorized access on the CX Ranch. – Increase motorized trespass. – 1,100 short term acres disturbed and 500 long term acres during CBM exploration and production activities.	• Federal: – Increase fire hazard and motorized access during 20-year lease. – Limit public access. – Disrupt active logging operations. – 25,600 short term acres and 15,250 long term acres disturbed during CBM development activities. • State: – Displace agricultural lands and disrupt irrigation system, increase cost of farm operation. – Reduced property values. – Displace community and residential growth. – Increase dust and noise impacts on residential use. – Increase cost of county road maintenance. – Increase long-term motorized access. – invite illegal trespass activities. – Increase forest pests. – Disrupt active logging operations. – Increase motorized trespass. – 29,750 short term acres and 17,700 long term acres disturbed during CBM development activities.	• All Federal and State impacts in Alternative B occur in Alternative C in addition to: – Impacts to adjacent mining operations The land use displacement from roads and utility lines lease operations is greatest in Alternative C. – Increased disturbances by CBM activities on private, state and federal estates. Short term disturbances 70,000 acres (Federal 32, 400, State 37,600); long term disturbances 47,600 acres (Federal 22,000, State 25,600).	• All Federal and State impacts in Alternative B occur in Alternative D in addition to: – Federal: Permanent loss of land use from road network.	• Federal and State: – Levels of disturbance would be slightly increased due to use of impoundments for production water management (Short term 74,000 acres, long term 44,000 acres). – Impacts from powerlines, roads, pipelines, and other utilities not requiring transportation corridors would be the same as Alternative C.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Lands and Realty (cont'd.)					
	• Total cumulative long term disturbance including all foreseen projects such as coal mine expansion, transportation etc. is estimated at 34,000 acres.	• Total cumulative acres disturbed long term including all foreseen projects 81,000	• Total cumulative long term acres disturbed would be approximately 102,300.		• Total cumulative long term acres disturbed would be approximately 92,200.
Livestock Grazing *AUM is equal to the amount of forage required to support one cow and her calf or 5 sheep for one month.* *The CBM Emphasis area has an estimated 1,207,400 acres of classified grazing and forested lands capable of supporting 323,941 AUMs.*					
	• Exploration wells located within BLM-permitted rangelands would result in the temporary loss of 69 AUMs. • State: – The exploration wells and production wells located at CX Ranch would result in a maximum construction loss of 272 AUMs on state and private rangelands combined. – Re-vegetating parts of the well pads during production would reduce the state-permitted losses to 194 AUMs.	• Exploration wells would result in the temporary loss of 413 AUMs (BLM 163, State 250). • Production wells would result in a maximum construction loss of 11,960 AUMs (BLM 4,770, State 7,190). • Re-vegetating parts of the well pads during production would reduce the losses to 6,904 AUMs (BLM 2,484, State 4,420). • If all Alternative requirements were utilized fully, the area of surface disturbances could be reduced by an additional 35 percent during construction and 40 percent during production primarily because of required transportation corridors.	• Impacts to livestock grazing would be similar to but slightly greater than those in Alternative B due to the discharge of untreated production water on to the ground resulting in increased erosion and no requirements for transportation corridors. • CBM discharge water could be used for livestock watering; increased erosion would result in increased surface disturbance, which could lead to disrupted grazing patterns, undermined fencing, and reduced forage; an increase of noxious weeds and a decrease in forage material could occur if discharged produced water is too high in saline content; and possible health effects to livestock if produced water that is unsuitable for livestock watering.	• Impacts would be similar to Alternative B with some exceptions: disturbed acreage would increase due to the piping of discharge water to the nearest disposal point. There would be a reduction to forage losses from increased land application of produced water; and there would be less soil and forage loss from erosion of soils. • Transportation corridor and road impact causing reductions of surface disturbance would be similar to Alternative B.	• Impacts to livestock grazing would be similar to Alternative B. Suitable CBM discharge water could be used for livestock watering. • Transportation corridor impacts would be the same as Alternative B. • Not as much forage would be lost under this alternative because increased land application of produced water would allow more growth. There would also be less soil and forage loss from soils erosion because more vegetation would hold the soils in place.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Paleontological Resources *Paleontological resources consist of fossil-bearing rock formations that underlie the entire planning area. Fossil outcrops are relatively rare throughout the emphasis area, but know areas are protected.*					
	• It is unlikely that any of the 1,500 short term acres disturbed during CBM development activities would contain noteworthy paleontological resources. The 575-acre Bridger Fossil Area ACEC (only paleontological resource) would not be disturbed. • Other impacts would include vandalism and removal of fossils by amateur fossil collectors resulting from minor increased accessibility to remote areas.	• Impacts for Alternative B, C, D, and E would be nearly the same based on level of disturbance, known locations of rich fossil areas, geological formation for paleontological features and protected ACECs. • There would be between 55,400 and 74,000 short term acres disturbed during CBM development activities increasing the chances that a minor fossil discovery would be made. Cumulative impacts would disturb an additional 33,400 acres increasing the likelihood of additional fossil discoveries. • Increased access would include increased vandalism and removal of fossils by amateur fossil hunters.			
Recreation *Montana's natural features offer a variety of year-round recreational opportunities*					
	• Minor loss of land for recreation purposes, and the disruption to recreation activities. • Exploratory activities such as drilling and testing would temporarily displace game species locally.	• Moderate loss of land for recreation purposes and the disruption to recreational activities. • Increased opportunities for access to remote areas.	• Impacts would be similar to Alternative B with the exception that increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.	• Impacts would be similar to Alternative B.	• Impacts would be similar to Alternative B with the exception that no requirements for transportation corridors would moderately increase access to remote areas.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Socio-Economics *Socio-economics address the changes in demographics; social organization including housing attitudes, and lifestyles; economics such as employment, unemployment and per capita income; and, government revenue sources including taxes, state oil and gas lease income, federal mineral revenues and private landowner revenues.*					
	• No social impacts (only small changes in employment, population, demand for services, etc.). • Small impact on economic conditions as a result of new production wells.	• Social impacts would include new jobs and new population moving to the area. • Economic impacts include generation of new personal and government income. • Additional disposal costs associated with injection of produced water. • Additional demands on public services.	• Social impacts same as Alternative B, with increase in impacts on lifestyles and values. • Economic impacts same as Alternative B, with increase in impacts to water resource users.	• Social impacts same as Alternative B, with small increase in impacts on lifestyles and values. • Economic impacts same as Alternative B, with small increase in impacts to water resource users.	• Social impacts same as Alternative B, with the exception that public burden to maintain roads may increase depending on landowner access decisions. • Economic impacts same as Alternative B, except that oil and gas income may be less depending on water treatment costs.
Soils *Montana has a wide mix of geologic parent material, which produces a vast array of different soil types*					
	• There would be minor occurrences of soil erosion, runoff, and sedimentation, mostly during construction activities. • Approximately 1,500 acres would be disturbed short term during CBM exploration and construction activities. • 500 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.	• Soil disturbances could be reduced by 35 percent or higher on a per well basis over Alternative A. CBM activities would result in 55,400 short term acres being disturbed. • 32,950 acres would be disturbed longer term during CBM production, with a majority of the land reclaimed after production is ceased. • No impacts would occur made to soils from CBM waters.	• CBM development activities would disturb corridors. Approximately 70,000 short term acres of disturbed surface area during construction activities. • Surface discharge and irrigation of produced water could result in approximately 47,600 acres disturbed in the long term.	• Impacts including levels of disturbance would be similar to Alternative B. • One favorable side effect would be that more water would be available for irrigation.	• Impacts would be similar to Alternative B. There would be a slight increase in the level of disturbance due to increased use of impoundments to contain produced water. Short term acres disturbed would be approximately 74,000 while long term would be 44,000. • Produced water would be available for beneficial use including irrigation. • No impacts are expected to occur on irrigated lands or soils

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Solid and Hazardous Wastes *Solid and hazardous wastes are under the jurisdiction of the MDEQ for RCRA wastes, MBOGC for RCRA exempt wastes, and the EPA for wastes generated on tribal lands*					
	• Typical solid waste refuse can be disposed of in local landfills. • Drilling mud and cuttings can be disposed of onsite with the landowner's permission. • Minor impacts would also occur from the use of pesticides and herbicides during access and construction activities. • Cumulative impacts from other foreseen projects would result in increased waste generated at moderate levels for commercial disposal.	• Impacts for Alternative B, C, D, and E would include increased quantities of waste requiring onsite disposal or transportation to commercial landfills. • Oil and gas developers are responsible for any damages to property, real or personal, resulting from the lack of ordinary care during operations. Operators are required to maintain SPCC plans and immediately remove and spilled or unused non-exempt wastes from the sites therefore no long term impacts to private, state or federal lands would occur from waste products associated with CBM development.			
Vegetation *Emphasis area acreage by land classifications, overlying known coal reserves: Grasslands, 3.55 million; Shrublands, 1.8 million; Forests, 1.36 million; Riparian Areas, 378,000; Barren Lands, 372,000; and Other Areas, 700,000*					
	• 1,144 acres of native habitat would be impacted under this Alternative, more than half (580 acres) in grasslands. • Potential minor loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be slightly impacted by disturbances.	• 55,400 acres of native habitat could be impacted short term under this Alternative, more than half (21,450 acres) in grasslands. • Potential moderate loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbances.	• 70,000 acres of native habitat could be impacted short term under this Alternative, more than half (27,300 acres) in grasslands. • If SAR values exceed 10 in water, riparian vegetation would be impacted, affecting as many as 3,535 acres of riparian habitat. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbance, SAR values, and water level changes, particularly inundation.	• Native habitat disturbances would be similar to those discussed under Alternative B. • Hydrology changes may affect as much as 2,776 acres of riparian habitat due to increased stream flow. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbance and water level changes, particularly inundation.	• Impacts would be similar to those for Alternative D, however no riparian habitat would be affected. Short term impacts would be slightly increased (74,000 acres) due to the use of impoundments for water management practices.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Visual Resource Management *Visual resources include Montana features such as landform, water, vegetation, color, adjacent scenery, uniqueness, structures and man-made features of aesthetic value*					
	• Federal and State: – Dust emissions would reduce visibility to a small degree near active field operations. – Well pads, roads, and compressors would disrupt the visual landscape. Semi-permanent structures are designed to blend into the surrounding environment. – Drill rigs, two-track trails, heavy road-making equipment, and generators would disrupt the visual landscape short-term.	• Federal: – There would be impacts to VRM BLM Class III and IV areas only. • Type of impacts common to Alternative A would occur with Alternative B, though at a scale commensurate with development. • View shed impacts from road network would last for 20 years and then reclaimed.	• Impacts common to Alternative B would occur with Alternative C, in addition to the following: • Above ground powerlines would greatly impact skyline and viewshed. • Visual impacts from roads and utility lines is greatest with this alternative until reclamation.	• Impacts common to Alternative B would occur with Alternative D, in addition to the following: • Production related roads that are not reclaimed and made part of the permanent road network would result in permanent visual impact.	• Impacts would be reduced from Alternative C by the mitigation measures in the Project Plan of Development for visual resources. • Impacts would be mitigated as described under the Alternative B, *Mitigation* subsection.
Wilderness Study Areas *There are 10 WSAs within the CBM emphasis area*					
	• BLM WSAs are closed to oil and gas leasing so there would be no direct impacts to WSAs. • Because there would be no production activities in BLM planning areas under this alternative, there would be no impacts.	• There would be no direct impacts to WSAs from CBM development.	• Same as Alternative B.	• Same as Alternative B.	• Same as Alternative B. • There would be no direct impacts to WSAs from CBM development. • Laws and regulations established for WSAs prohibit leasing of WSAs designated lands for resource extraction.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Wildlife *Mammal Species:* *- 10 bats* *- 8 shrews* *- 34 small mammals and lagomorphs* *- 17 predators* *- 4 big game*	*Bird Species:* *.- 32waterfowl* *- 33 shore & wading birds* *- 18 diurnal &* *- 11 nocturnal raptors* *- 8 gallinaceous* *- 8 wood peckers* *- 137 songbirds*	*Reptiles and Amphibian species:* *- 1 salamander* *- 4 frogs* *- 4 toads* *- 3 turtles* *- 2 lizards* *- 9 snakes*		*Species of Concern consist of 16 mammals, 6 reptiles and amphibians, and 22 birds, including:* *- Sage Grouse* *- Interior Least Tern* *- Gray Wolf* *- Canada Lynx* *- Grizzly Bear*	*- Mountain Plover - Bald Eagle* *- Peregrine Falcon* *- Black-tailed Prairie Dog* *- Black-footed Ferret*
	• Direct and indirect impacts would occur at a level commensurate with the level of CBM development. • Direct impacts include habitat loss, death from vehicle collisions, and effects associated with greater human access into previously untraveled areas. • Indirect impacts on wildlife include disturbance and displacement, stress, power lines, noxious weed invasion, user-created roads, habitat fragmentation, water quality degradation from road runoff, and increased livestock grazing. • Indirect impacts on wildlife would occur on 33,840 to 84,000 acres. • Through mitigation, this Alternative would not directly impact any T&E listed wildlife species. Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, would be low because of the limited number of CBM wells permitted.	• Same as Alternative A but on a much larger scale. Twenty-five times as many wells, roads, and utility corridors as under Alternative A. • 6,680 miles of roads (2.9 to 8.8 miles per square mile). • 20,697 miles of utility corridors (9 to 27.1 miles per square mile). • Indirect impacts to wildlife on 884,000 to 4.7 million acres. • Additional types of impacts include loss of high value habitats such as prairie dog towns, sage grouse leks, and big game winter range. • Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal. Through mitigation, this Alternative would not directly impact any T&E listed wildlife species. •	• Direct and indirect impacts would occur at a level commensurate with the level of CBM development. Indirect impacts to wildlife on 884,000 to 4.7 million acres from: – 9,018 miles of roads (3.9 to 11.9 miles per square mile). – 27,917 miles of utility corridors (12.2 to 36.6 miles per square mile). – Discharge of untreated CBM water into drainages would impact riparian and wetland habitat and associated species because of poor water quality and erosion. – Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water. • Through mitigation, this Alternative should not directly impact any T&E listed wildlife species.	• Impacts would be similar to Alternative B. • Discharged treated CBM water would erode riparian and wetland habitat. • Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water. • Through mitigation, this Alternative would not directly impact any T&E listed wildlife species. • Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, would occur at a level less than Alternative C. – Potential indirect impacts to T&E species from hydrology changes caused by increased water levels may impact nesting Interior Least Terns. If hydrology changes from surface water runoff, cause riparian vegetation changes, other T&E species may be impacted as well, such as nesting Bald Eagles.	• Direct and indirect impacts would occur similar to Alternative B. • Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres depending on development spacing. • Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal. • Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water. • Through implementation of WMPP & BO impacts to T&E listed species would be minimized. – Species of concern not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Wildlife (cont'd.)	• Species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment.	• Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, could occur. Impacts would be less than C or D with the restricting of utilities and roadways to the same corridor. • All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment and by increased access through increased roads.	• Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, are greater under this Alternative than any other because of the increased number of CBM wells permits.. • Potential indirect impacts to T&E species from changes in riparian habitat due to increased SAR values and hydrology are likely to occur under this Alternative. Bald Eagles and Interior Least Terns may also be affected if SAR changes affect forage fish. • Species of concern not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment or by changing streambed hydrology and increased SAR and salinity values in water and soil. • More water would be available for wildlife.	– Species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment or by changing streambed hydrology.	– These impacts would be less than alternative B, C and D through the implementation of the Wildlife Monitoring and Protection Plan. – More water would be available for wildlife as a result of CBM production.

TABLE S-2
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Wildlife (Aquatic Resources) *Fish species vary between watersheds within the CBM emphasis area from 8 in the Little Big Horn River to 32 in the Musselshell River* *Special Status Aquatic Species:* *- Montana Arctic grayling* *- Pallid sturgeon* *- Warm spring zaitzevian riffle beetle*					
	• Minor short-term impacts on aquatic resources during CBM exploration and production may result from increased sediment delivery and its effects on aquatic habitat and organisms, possible impedance of fish movements, potential for accidental spills of petroleum products, and possibly increased fish harvest. • Relatively minor long-term increases in river flow and TDS concentration from production water discharge would not be expected to impact aquatic resources. • Conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges. • Impacts from CBM abandonment would be minor and subside over time.	• The same types of impacts described for Alternative A (No Action) would occur under Alternative B. • The scale of potential impacts associated with sediment delivery, fish movements, petroleum spills, and fish harvest would be much greater under Alternative B because of the development of over 18,000 CBM wells across a much larger geographic area. • No CBM production water would be discharged to surface drainages under Alternative B and there would be no potential for impacting aquatic resources from this particular activity. • Based on fish species present, fisheries management policies, fisheries resource values, and the projected intensity of CBM development, the drainages most sensitive to the effects of CBM development would be the Lower Bighorn, Upper Tongue, and Little Bighorn; then the Lower Tongue, Little Powder, and Rosebud; followed by the Mizpah. • The potential for affecting aquatic resources in sensitive drainages would be less under Alternative B than under Alternatives C or D.	• The same types of impacts described for Alternative A would occur under Alternative C, but they would occur on a far greater scale because of the development of over 18,000 CBM wells. • A total of 0.67 billion cubic feet of untreated CBM production water would be discharged to drainages each year. Resultant flow and TDS increases could potentially impact aquatic organisms, especially in smaller drainages during dry times of the year. • Conditions of MPDES Permits would provide legally enforceable assurances preventing the degradation of water quality, aquatic resources, and the beneficial uses of receiving waters. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative C than under Alternatives B or D.	• The same types of impacts described for Alternative A would occur under Alternative D, but they would occur on a far greater scale because of the development of over 18,000 CBM wells. • The annual discharge of 2.24 billion cubic feet of treated CBM production water through pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year. • The treatment of CBM production water prior to its discharge would greatly reduce the potential for elevated TDS and salinity impacts on aquatic resources. • MPDES Permits would provide legal assurances that water quality, aquatic resources, and beneficial uses of receiving waters would be protected. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative D than under Alternative B but less than under Alternative C.	• Same as Alternative B. • Implementation of wildlife monitoring and Protection Plan would reduce impacts to aquatic habitat wildlife and invertebrates.

☆ U.S. GOVERNMENT PRINTING OFFICE: 2002 — 573-102 / 68004 Region No. 8

TABLE OF CONTENTS

Section **Page**

Volume One

ABSTRACT ABS-1

SUMMARY SUM-1
- Introduction SUM-1
  - The Planning Area SUM-1
  - Preparers of the FEIS SUM-1
  - Coal Bed Methane SUM-1
- Chapter 1: Purpose and Need SUM-2
  - Conformance with BLM Land Use Plans SUM-2
  - Consultation SUM-2
- Chapter 2: Alternatives SUM-6
  - Alternatives Considered SUM-6
  - Comparison of Impacts SUM-6
- Chapter 3: Affected Environment SUM-11
- Chapter 4: Environmental Consequences SUM-12
  - Resources with Low Intensity Impacts SUM-12
  - Resource Impacts that are Important Features of Alternative E SUM-12
- Chapter 5: Consultation and Coordination SUM-14

ACRONYMS ACR-1

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION 1-1
- Introduction 1-1
- Conformance With the BLM Land Use Plans 1-1
- The Planning Area 1-2
- Purpose of and Need for Action 1-2
- Planning Criteria 1-2
  - Introduction 1-2
  - Overall Considerations 1-5
- Roles and Agency Responsibilities 1-5
  - Bureau of Land Management 1-5
  - State of Montana 1-7
  - Tribal Governments 1-10
  - Other Federal Agencies 1-12
- Issues 1-19
  - Air Quality and Climate 1-19
  - Cultural Resources 1-19
  - Geology and Minerals 1-19
  - Hazardous Materials and Waste Management 1-19
  - Hydrology 1-19
  - Indian Trust Resources and Native American Concerns 1-20
  - Lands and Realty 1-20
  - Livestock Grazing 1-20
  - Paleontological Resources 1-20
  - Recreation 1-20

Section **Page**

Social and Economic Values 1-20
Environmental Justice 1-21
Soils 1-21
Vegetation 1-21
Visual Resource Management 1-22
Wilderness Study Areas 1-22
Wildlife 1-22

CHAPTER 2: ALTERNATIVES 2-1
Introduction 2-1
Alternatives Development 2-1
Air Quality 2-1
Coal Mines 2-1
Coal Bed Methane 2-1
Hydrology 2-2
Realty 2-2
Indian Trust Resources 2-2
Environmental Mitigation 2-2
Alternatives Considered But Not Analyzed in Detail 2-2
Leasing 2-2
Bonding 2-3
Omega Alternative 2-3
Alternate Sources of Energy 2-3
Re-Injection of Produced Water into the Same Aquifer Alternative 2-3
Phased Development 2-4
Management Common to All Alternatives 2-4
Bureau of Land Management 2-4
State of Montana 2-4
Mitigation Measures 2-5
Management Actions Specific to Each Alternative 2-5
Alternative A—No Action (Existing Management) 2-5
Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources 2-10
Alternative C—Emphasize CBM Development 2-12
Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses 2-12
Alternative E—Preferred Alternative 2-13
Comparison of Alternatives 2-17

CHAPTER 3: AFFECTED ENVIRONMENT 3-1
Introduction 3-1
Air Quality 3-1
Topography 3-1
Climate and Meteorology 3-1
Existing Air Quality 3-1
Regulatory Framework 3-3
Cultural and Historical 3-5
Geology and Minerals 3-8
Regional Geology 3-9
Stratigraphy 3-9
Sediments in the Powder River Basin 3-10
Conventional Oil and Gas 3-20
Coal Bed Methane 3-20
Coal 3-20
Mineral Materials 3-21

Section **Page**

Locatable Minerals 3-21
Hydrological Resources 3-22
Surface Water 3-22
Groundwater 3-31
Water Rights 3-38
Indian Trust Assets 3-40
Background 3-40
Applicable Laws 3-40
The Crow Tribe 3-41
The Northern Cheyenne Tribe 3-41
Fort Belknap Community 3-42
The Turtle Mountain Public Domain Allotments 3-42
Lands and Realty 3-43
Livestock Grazing 3-47
Native Americans 3-48
The Crow Indian Reservation 3-48
Northern Cheyenne Reservation 3-57
Paleontological Resources 3-73
Recreation 3-74
Federal 3-74
State 3-74
Local/City Recreation 3-75
Private Lands 3-75
Social and Economic Values 3-76
Demographics 3-76
Social Organization 3-80
Economics 3-82
Government Revenue Sources 3-87
Environmental Justice 3-93
Soils 3-95
Solid and Hazardous Wastes 3-96
Vegetation 3-97
Plant Communities 3-97
Species of Concern 3-98
Visual Resource Management 3-100
Wilderness Study Areas 3-101
Wildlife 3-102
Mammals 3-102
Birds 3-103
Reptiles and Amphibians 3-105
Species of Concern 3-105
Aquatic Resources 3-108

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES 4-1
Introduction 4-1
Analysis Assumptions and Guidelines 4-1
Potential for Development—Reasonably Foreseeable Development Scenario 4-1
Assumptions Common to All Alternatives 4-5

Section **Page**

Resource Topics 4-13
  Air Quality and Climate 4-13
  Cultural Resources 4-37
  Geology and Minerals 4-41
  Hydrological Resources 4-47
  Indian Trust and Native American Concerns 4-87
  Lands and Realty 4-94
  Livestock Grazing 4-101
  Paleontological Resources 4-105
  Recreation 4-107
  Social and Economic Values 4-111
  Soils 4-134
  Solid and Hazardous Waste 4-141
  Vegetation 4-143
  Visual Resource Management 4-154
  Wilderness Study Areas 4-157
  Wildlife 4-159

CHAPTER 5: CONSULTATION AND COORDINATION 5-1
Introduction 5-1
Public Participation 5-1
Consultation with U.S. Fish and Wildlife Service on Threatened and Endangered Species 5-2
Consultation and Coordination with Native American Tribes 5-2
Consistency 5-3
Comments and Responses 5-4
  Alternatives and Other Management Concerns 5-4
  Air Quality and Climate 5-13
  Cultural Resources 5-30
  Geology and Minerals 5-32
  Hydrological Resources 5-41
  Lands and Realty 5-64
  Livestock Grazing 5-68
  Recreation 5-69
  Social and Economic Values 5-70
  Soils 5-85
  Solid and Hazardous Waste 5-88
  Vegetation 5-89
  Visual Resource Management 5-93
  Wilderness Study Areas 5-93
  Wildlife 5-94
Distribution List 5-111
List of Preparers 5-121
BLM Coordination Support and Review 5-121

Tables

S-1 Alternative Management For CBM SUM-7
S-2 Comparison Summary of Impacts SUM-15
1-1 Applicable Permits/Reviews for Oil and Gas Development Activities 1-14
1-2 Permitable Activities for CBM Development 1-17
2-1 Mitigation Measures Common to All Alternatives 2-5
2-2 Alternative Management for CBM 2-18
2-3 Comparison Summary of Impacts 2-22

Tables **Page**

3-1 Assumed Background Concentrations of Regulated Air Pollutants (μg/m^3) ... 3-2
3-2 Applicable Ambient Air Quality Standards and PSD Increment Values (μg/m^3) ... 3-4
3-3 Cultural Resource Sites Identified by SHPO within each County of the Planning Area ... 3-6
3-4 Surface Water Discharge and Water Quality For 7Q10 And Low Monthly Mean Flows at Selected USGS Stations ... 3-26
3-5 Water Use (in Millions of Gallons per Day) Statistics in 1995 by Watershed and/or Groundwater Use ... 3-28
3-6 Impaired Water Bodies in Area of Maximum CBM Potential ... 3-29
3-7 Planning Area Aquifers and Their General Characteristics ... 3-35
3-8 Groundwater Quality for the Montana Portion of the Powder River Basin ... 3-38
3-9 Water Rights Development Summary by Watershed ... 3-39
3-10 Indian Trust Assets ... 3-40
3-11 Land Ownership ... 3-44
3-12 Miles of Road/Highway ... 3-45
3-13 Miles of Railroad ROW ... 3-46
3-14 Tribal Poverty Rates Among Those Employed (1999) ... 3-50
3-15 Average Annual Unemployment Rates by Reservation ... 3-50
3-16 Groundwater Sodium Absorption Ratio and Total Dissolved Solids Values, Crow Indian Reservation ... 3-55
3-17 Average Annual Gage and Estimated Natural Flows for the Tongue River near the Northern Cheyenne Reservation (Study Period 1940-1982, HKM 1983) ... 3-63
3-18 Average Estimated Natural Flows for Rosebud Creek, Northern Cheyenne Reservation (Study Period 1939-1981) ... 3-63
3-19 Comparison of Previously Cited Water Quality Parameters with Long-Term Average Figures, Tongue River at State Line ... 3-63
3-20 Water-Quality of the Alluvium on the Northern Cheyenne Reservation ... 3-66
3-21 Revised Numeric Standards for EC and SAR and TDS Indicator Values ... 3-70
3-22 Historical Population and Population Forecasts ... 3-76
3-23 Race/Ethnicity as Percent of Total Population ... 3-77
3-24 Poverty Status by County (as Defined by U.S. Census Bureau) (1997) ... 3-79
3-25 Housing Units ... 3-81
3-26 Montana Employment Trends by Sector ... 3-83
3-27 State Employment Versus Planning Area Employment by Sector (1998) ... 3-84
3-28 Planning Area Employment by County and Sector (1998) ... 3-85
3-29 Average Annual Unemployment Rates by County ... 3-86
3-30 Tribal Workforce and Unemployment (1999) ... 3-87
3-31 Per Capita Income, 1996-1998 ... 3-88
3-32 Total Taxes Collected in Montana (2000) ... 3-89
3-33 Revenues Received from Minerals Management on State Lands in FY 2000 ... 3-90
3-34 Onshore Federal Mineral Revenue Disbursements Identified by County of Origin, Fiscal Year 2000, Montana ... 3-91
3-35 Endangered, Threatened, and Proposed Plant Species Present in the CBM Emphasis Area ... 3-99
3-36 Endangered, Threatened, and Proposed Animal Species Present in the CBM Emphasis Area ... 3-106
3-37 Special Status Aquatic Species Present in the CBM Emphasis Area ... 3-113
4-1 Level of Disturbance ... 4-6
4-2 Non-Project and Project Total Emissions Summary ... 4-16
4-3 Alternative A—Project Sources Criteria Pollutant Impacts ... 4-20
4-4 Alternative A Potential NAAQS/MAAQS Exceedances ... 4-21
4-5 Alternative A Potential PSD Increments Exceedances ... 4-21
4-6 Alternative A Class I Area Potential Visibility Impacts ... 4-21
4-7 Alternative A Class ... 4-23
4-8 Alternative B—Project Sources Criteria Pollutant Impacts ... 4-25
4-9 Alternative B Potential NAAQS/MAAQS Exceedances ... 4-27
4-10 Alternative B Potential PSD Increments Exceedances ... 4-27

Tables **Page**

4-11 Alternative B Class I Area Potential Visibility Impacts 4-29
4-12 Alternative B Class II Area Potential Visibility Impacts 4-30
4-13 Alternative D—Project Sources Criteria Pollutant Impacts 4-32
4-14 Alternative D Potential NAAQS/MAAQS Exceedances 4-32
4-15 Alternative D Potential PSD Increments Exceedances 4-33
4-16 Alternative D Class I Area Potential Visibility Impacts 4-34
4-17 Alternative D Class II Area Potential Visibility Impacts 4-35
4-18 Summary of Proposed Limits for Montana Surface Water 4-49
4-19 Effects on Surface Waters of the Tongue River under Alternative A 4-53
4-20 Effects on Surface Waters in the Powder River under Alternative A 4-53
4-21 Effects on Surface Waters of the Little Powder River under Alternative A 4-54
4-22 Effects on Surface Water of Mizpah Creek under Alternative A 4-55
4-23 Effects on Surface Waters of the Little Bighorn and Bighorn Rivers under Alternative A 4-56
4-24 Effects on Surface Water of Rosebud Creek under Alternative A 4-56
4-25 Effects on Surface Water of the Yellowstone River Under Alternative A 4-57
4-26 Groundwater Depletion by CBM Development in the Montana Powder River Basin 4-63
4-27 Effects on Surface Waters of the Tongue River under Alternative C 4-67
4-28 Effects on Surface Waters in the Powder River under Alternative C 4-68
4-29 Effects on Surface Waters in the Mizpah Creek under Alternative C 4-69
4-30 Effects on Surface Waters of the Bighorn and Little Bighorn Rivers under Alternative C 4-70
4-31 Effects on Surface Water of Rosebud Creek under Alternative C 4-71
4-32 Effects on Surface Water of the Yellowstone River under Alternative C 4-72
4-33 Summary of Surface Water Parameters Before and After Mixing Untreated CBM Discharge from Wyoming and Treated CBM Discharges from Montana Under Alternative D 4-73
4-34 Effects on Surface Water Forecast to the Tongue River Under the Preferred Alternative E 4-76
4-35 Water Management Framework for the Tongue River Watershed under the Preferred Alternative 4-78
4-36 Effects on Surface Waters of the Little Bighorn and Bighorn Rivers Under the Preferred Alternative E 4-79
4-37 Water Management Framework for the Bighorn River Watershed under the Preferred Alternative E 4-80
4-38 Effects on Surface Water in the Rosebud Creek Under the Preferred Alternative E 4-80
4-39 Water Management Framework for the Rosebud Creek Drainage under the Preferred Alternative E 4-80
4-40 Effects on Surface Water in the Powder River Under the Preferred Alternative E 4-81
4-41 Effects on Surface Waters of Mizpah Creek Drainage Under the Preferred Alternative E 4-82
4-42 Water Management Framework for the Powder River Watershed under the Preferred Alternative E 4-82
4-43 Water Management Framework for the Mizpah Creek Drainage under the Preferred Alternative E 4-83
4-44 Effects on Surface Water in the Yellowstone River Under the Preferred Alternative E 4-83
4-45 Water Management Framework for the Yellowstone Watershed Upstream Sidney, MT under the Preferred Alternative E 4-84
4-46 Cumulative Impacts on Surface Waters under Wyoming's Alternative 2A and Montana's Alternative E 4-85
4-47 Number of Predicted Animal Unit Months (Aums) Lost to Exploration, Construction, and Production 4-103
4-48 Alternative A: Estimated Wages and Jobs for Well Development, Production, and Abandonment 4-113
4-49 Alternatives B, C, D, and E: Estimated Wages and Jobs for Well Development, Production, and Abandonment 4-117
4-50 Total Proposed Wells and Percent By County (Alternatives B, C, D, and E) 4-119
4-51 Example: Partial District-Wide Weed Prevention Schedule 4-145
4-52 Amount of Acreage with Underlying Coal Beds in Each Habitat Type (by RMP Area and State Land) 4-147
4-53 Acreage Potentially Impacted in Each Habitat Type for Alternative A (by RMP Area and State-Permitted Land) 4-147
4-54 Acres of Land and Length of Roads and Utility Corridors Directly Impacted by New CBM Construction 4-150

Tables **Page**

4-55 Existing Wildlife-Related Lease Stipulations Covering CBM Exploration and Development on BLM Lands 4-161
4-56 Vulnerability of Wildlife to Types of CBM Impacts, Alternative A 4-165
4-57 Area of Indirect Impacts and Indirect Wildlife Disturbance and Displacement Within and Around CBM Well Fields for More Sensitive Wildlife Species for Alternatives B, C, D, and E 4-173

Figures ....

3-1 Stratigraphic Column of the Teriary, Mesozoic, and Part of the Paleozoic Sediments in the Montana and Wyoming Portions of the Powder River Basin....3-16
3-2 Stratigraphic Column of Upper Cretaceous and Lower Tertiary Sediments in the Powder River Basin....3-17
3-3 Stratigraphic Variation of the Anderson-Canyon Coals in the Area of the Decker Mine, Powder River Basin, Montana (Roberts et al., 1999a) 3-18
3-4 Variation in Surface Water Quality with Flow at USGS Station 06306300 on the Tongue River near Decker, Based upon USGS Data from October 16, 1985 to September 12, 2000....3-27
3-5 Principal Aquifers 3-37
4-1 Production at the CX Ranch....4-11
4-2 Water Quality Plot Before and After Mixing with Wyoming's Alternative 2A and Montana's Alternative CBM Discharges, Tongue River near Decker, Montana 4-76

Maps

S-1 Planning Areas SUM-3
1-1 Planning Areas 1-3
3-1 Tectonic Element Map of the State of Montana....3-11
3-2 Statewide Outcrop Geology 3-12
3-3 Statewide Coal Occurrence Map....3-13
3-4 Outcrop Geology and Clinker Deposits of the Montana Portion of Powder River Basin 3-14
3-5 Water Well Use, Current CBM Production, and CBM Likelihood in Powder River Basin....3-15
3-6 Surficial Aquifers 3-23
3-7 Surficial Aquifers—Water Quality....3-24
3-8 Powder River Basin Watersheds and Area USGS Gauging Stations 3-25
3-9 Bedrock Aquifers 3-33
3-10 Bedrock Aquifers—Water Quality....3-34
4-1 CBM Development Based on Reasonably Foreseeable Development Scenario 4-3
4-2 Location Map, Regional Coal Mines....4-59

Glossary....**GLO-1**

Bibliography....**BIB-1**

Index **IND-1**

Volume Two

Appendices

Air Quality
Hydrology
Minerals
Monitoring
Northern Cheyenne Proposed Mitigation
Socioeconomics
Soils
Solid and Hazardous Waste
Vegetation
Wildlife

Acronyms and Abbreviations

Δdv	change in deciview
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ADT	average daily traffic
AOU	American Ornithologist's Union
ANC	acid neutralizing capacity
APD	Application for Permit to Drill
APLIC	Avian Power Line Interaction Committee
AQRV	Air Quality Related Value
ARCO	Atlantic-Richfield Company
ARM	Administrative Rules of Montana
Argonne	Argonne National Laboratory
ARS	Agricultural Research Service
AUMs	animal unit-months
AWM	Air and Waste Management Bureau
BACT	Best Available Control Technology
BCF	billion cubic feet
BER	Board of Environmental Review
bgs	below ground surface
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
BTU	British thermal unit
CAA	Clean Air Act
CBM	coal bed methane
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFS	cubic feet per second
CH_4	methane
CO	carbon monoxide

CO_2	carbon dioxide
COA	Condition of Approval
COE	U.S. Army Corps of Engineers
CSU	Controlled Surface Use
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
DNRC	Department of Natural Resources and Conservation (Montana)
dv	deciview
EA	Environmental Assessment
EC	electrical conductivity
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FLM	Federal land managers
FLPMA	Federal Land Policy and Management Act
FR	Federal Register
FWS	Fish and Wildlife Service (USDI)
FY	fiscal year
gpm	gallons per minute
GPO	Government Printing Office
GTI	Gas Technology Institute
HAP	hazardous air pollutants
HCP	Habitat Conservation Plan
HUD	U.S. Department of Housing and Urban Development
H_2S	hydrogen sulfide
ICC	Interstate Commerce Commission
ITA	Indian Trust Assets
kW	kilowatt

LGST	local government severance taxes
LRPL	Least Restrictive Proposed Limit
MAAQS	Montana Ambient Air Quality Standards
MBMG	Montana Bureau of Mines & Geology
MBOGC	Montana Board of Oil & Gas Conservation
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MCF	thousand cubic feet
MDA	Montana Department of Agriculture
MDEQ	Montana Department of Environmental Quality
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MFWP	Montana Fish, Wildlife, and Parks
mg/l	milligrams per liter
MGWPCS	Montana Groundwater Pollution Control System
MMB	Minerals Management Bureau
MNHP	Montana Natural Heritage Program
MPDES	Montana Pollutant Discharge Elimination System
MOA	Memorandum of Agreement
MRPL	Most Restrictive Proposed Limit
MSO IM	Montana State Office Instruction Memorandum
MTDEQ-AWM	Montana DEQ-Air & Waste Management Bureau
MT-GAP	Montana Gap Analysis Project
MOU	Memorandum of Understanding
MYBP	Millions of Years Before Present
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System

ACRONYMS AND ABBREVIATIONS

NPS	National Park Service (USDI)
NRCS	Natural Resources Conservation Service (USDA)
NRHP	National Register of Historic Places
NRIS	Natural Resource Information System (Montana)
NSO	no surface occupancy
NWP	Nationwide 404 Permit
NWR	National Wildlife Refuge
OF	Open File (Report)
OSHA	Occupational Safety and Health Administration
PM_{10}	particulate matter less than 10 microns in diameter (inhalable particulate matter)
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter (fine particulate matter)
POD	Plan of Development
ppm	parts per million
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psig	pounds per square inch gauge
RCRA	Resource Conservation and Recovery Act of 1976
RFFA	Reasonably Foreseeable Future Actions
RFD	Reasonably Foreseeable Development
RMP	Resource Management Plan
RMU	Regional Monitoring Unit
ROD	Record of Decision
ROW	right-of-way
SAR	Sodium Adsorption Ratio
SCMA	Surface Coal Mining Act of 1977
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Office
SIP	State Implementation Plan (Montana)
SMA	Special Management Area
SOC	Species of Concern
SN	Sundary Notice
SO_2	sulfer dioxide
SR	State Road (when followed immediately by the State Road number)

SWQATR	Surface Water Quality Analysis Technical Report
T&E	Threatened and Endangered
TAC	Technical Advisory Committee
TCF	trillion cubic feet
TCP	traditional cultural property
TDS	total dissolved solids
TLMD	Trust Land Management Division
TMDL	total maximum daily load
TOC	total organic carbon
μeq/1	microequivalents per liter
$\mu g/m^3$	micrograms per cubic meter
μS/cm	micro-Siemens per centimeter
UIC	underground injection control
U.S.	United States
USBR	Bureau of Reclamation (USDI)
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USDC	U.S. Department of Commerce
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service (USDA)
USGS	U.S. Geological Survey (USDI)
VOC	volatile organic compounds
VMT	vehicle miles traveled
VRM	visual resource management
WET	whole effluent toxicity
WMA	Wildlife Management Area
WMP	Water Management Plan
WMPP	Wildlife Monitoring and Protection Plan
WQS	water quality standards
WRTR	Water Resources Technical Report
WSA	Wilderness Study Area
WYDEQ	Wyoming Department of Environmental Quality

CHAPTER 1

PURPOSE AND NEED

MONTANA

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

Introduction

This Final Environmental Impact Statement (FEIS) was prepared jointly by the Bureau of Land Management (BLM) and the State of Montana (state). The Federal and State of Montana lead agencies for the development of the EIS are the BLM, Montana Board of Oil and Gas Conservation (MBOGC) in the Department of Natural Resources and Conservation (DNRC), and the Montana Department of Environmental Quality (MDEQ). The Environmental Protection Agency (EPA), Bureau of Indian Affairs (BIA), Department of Energy (DOE), and Crow Tribe of Indians are cooperating agencies for the EIS. The Northern Cheyenne Tribe has also participated in the development of this EIS.

The EIS has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and the Montana Environmental Policy Act (MEPA) of 1971. The EIS analyzes the impacts from future exploration and development of oil and gas resources statewide, with emphasis on the BLM planning area of the Billings and Powder River Resource Management Plan (RMP) areas, and Blaine, Gallatin, and Park counties.

BLM proposes to amend the Billings and Powder River RMPs. The existing Powder River and Billings RMPs, as amended by BLM's 1994 *Oil and Gas Amendment of the Billings, Powder River, and South Dakota RMPs,* address conventional oil and gas development and limited coal bed methane (CBM) exploration and development. Current projections by industry indicate heightened interest in the exploration and development of CBM. Both conventional oil and gas and expanded CBM development would constitute a major federal action with potential significant effects to the human environment. An EIS is needed to consider the impacts associated with amending the RMP to provide for CBM production. A RMP amendment is needed in order to allow BLM to change existing land use decisions regarding oil and gas operations.

The MBOGC has placed a moratorium on state-permitted CBM wells in Montana until the EIS is completed. The EIS will be used by the state to supplement its 1989 Final Programmatic EIS for permitting oil and gas activities, particularly large-scale CBM development.

Future oil and gas NEPA analysis by BLM or BIA or MEPA analysis by the State of Montana could tier from this EIS. BLM's approval of oil and gas activities in the planning area would be consistent with the requirements developed in this RMP amendment. Similarly, the state's approval of CBM activities would be based on this plan. If a Native American tribe proposes to develop its CBM resource, the BIA will need to comply with NEPA for its approval actions. The BIA could adopt this EIS, or tier from the EIS, for use in its NEPA analysis.

It is important to note that this EIS considers the impacts of CBM development from a broad, wide, planning perspective. Permits for individual drilling and development proposals would not be issued until site-specific NEPA or MEPA analysis had been completed.

Conformance With the BLM Land Use Plans

The Billings RMP was approved through a Record of Decision (ROD) issued by BLM September 28, 1984. The Powder River RMP was approved through a Record of Decision issued by BLM on March 15, 1985. BLM's 1994 Oil and Gas Amendment of the Billings, Powder River, and South Dakota RMPs amended these RMPs. The decisions made in the RMPs allow for a certain level of conventional oil and gas development on federal leases, support limited CBM exploration and development, but do not include analysis for full-scale CBM development:

> "The [1992] Reasonably Foreseeable Development [RFD] projections can accommodate the drilling of test wells and initial small-scale development of CBM. The extension of the

What has Changed in Chapter 1 Since the Draft EIS?

Chapter 1 contains the purpose and need for the action, and therefore forms the basis for the analysis of the alternatives. More text was added to the Roles and Agency Responsibilities section to provide additional clarity. Based on public comment, a new section was added to further define the role of Tribal governments in the EIS process. Finally, the list of agency-required permits was moved from Chapter 2 into Chapter 1 and a Permitable Activities matrix table was added to clarify the agencies involvement. The permit list is unchanged from the DEIS. Text throughout the chapter was revised for simpler presentation.

> nonconventional fuels tax credit for wells drilled before December 31, 1993, should generate some activity in the planning area. This amendment does not contain either a hydrologic analysis of the RFD area or an environmental study of the impacts of building major pipeline systems. In order for development to occur on federal oil and gas lands, an additional environmental document tied to this amendment would be required" (BLM 1992).

This 2003 EIS is that document.

The Planning Area

The planning area shown in Map 1-1 is the area where oil and gas decisions will be made by BLM and the State of Montana. The BLM's planning area is the oil and gas estate administered by the BLM in the Powder River and Billings RMP areas. The State of Montana's planning area is statewide, with emphasis on the state-administered oil and gas within the BLM planning area and in Blaine, Park, and Gallatin counties. The planning area excludes those lands administered by the Forest Service, and sovereign tribal governments, such as the Crow Tribe of Indians, and the Northern Cheyenne Tribe. Indian allotted lands are also excluded from the planning areas.

For ease of reference, the Billings and Powder River RMP areas, and Blaine, Park, and Gallatin counties, are referred to in the document as the BLM and state "CBM emphasis area." This is the 16-county area within the BLM and state planning area where there is CBM development interest.

The Powder River RMP area encompasses the southeastern corner of Montana, including Powder River and Treasure counties, and portions of Big Horn, Carter, Custer, and Rosebud counties. The Powder River RMP area comprises approximately 1,080,675 acres of federally managed surface and 4,103,700 acres of federal mineral estate.

The Billings RMP Area comprises the south-central portion of Montana consisting of Carbon, Golden Valley, Musselshell, Stillwater, Sweet Grass, Wheatland, and Yellowstone counties and the remaining portion of Big Horn County. The Billings RMP area comprises approximately 425,336 acres of federally managed surface and 906,084 acres of federal mineral estate.

Adjacent to the planning areas, other major land holdings include the Crow, Northern Cheyenne, and Fort Belknap Indian reservations, the Custer National Forest, the Big Horn Canyon National Recreational Area, the Burlington Northern and Santa Fe Railroad, and the Fort Keogh Agricultural Experiment Station. The total surface area of the CBM emphasis area (all owners) exceeds 25 million acres.

Purpose of and Need for Action

The BLM is responsible for managing federally owned oil and gas resources. During the October 18, 2000, meeting of the Coal Bed Methane Coordination Group, oil and gas industry representatives presented their predictions for the number of CBM wells that might be drilled within the planning area.

The purpose of the EIS is to analyze impacts from oil and gas activity, particularly from CBM exploration, production, development, and reclamation in the Billings and Powder River RMP areas. This EIS is being used to analyze options for BLM to change its planning decisions by considering oil and gas management options including mitigating measures that will help minimize the environmental and social impacts related to CBM activities. The alternatives presented provide a range of management options for amending the RMPs. The preferred alternative (Alternative E) is BLM's proposed RMP amendment. The EIS will focus the analysis on the oil and gas development issues not covered in the current RMPs, such as water management from CBM production.

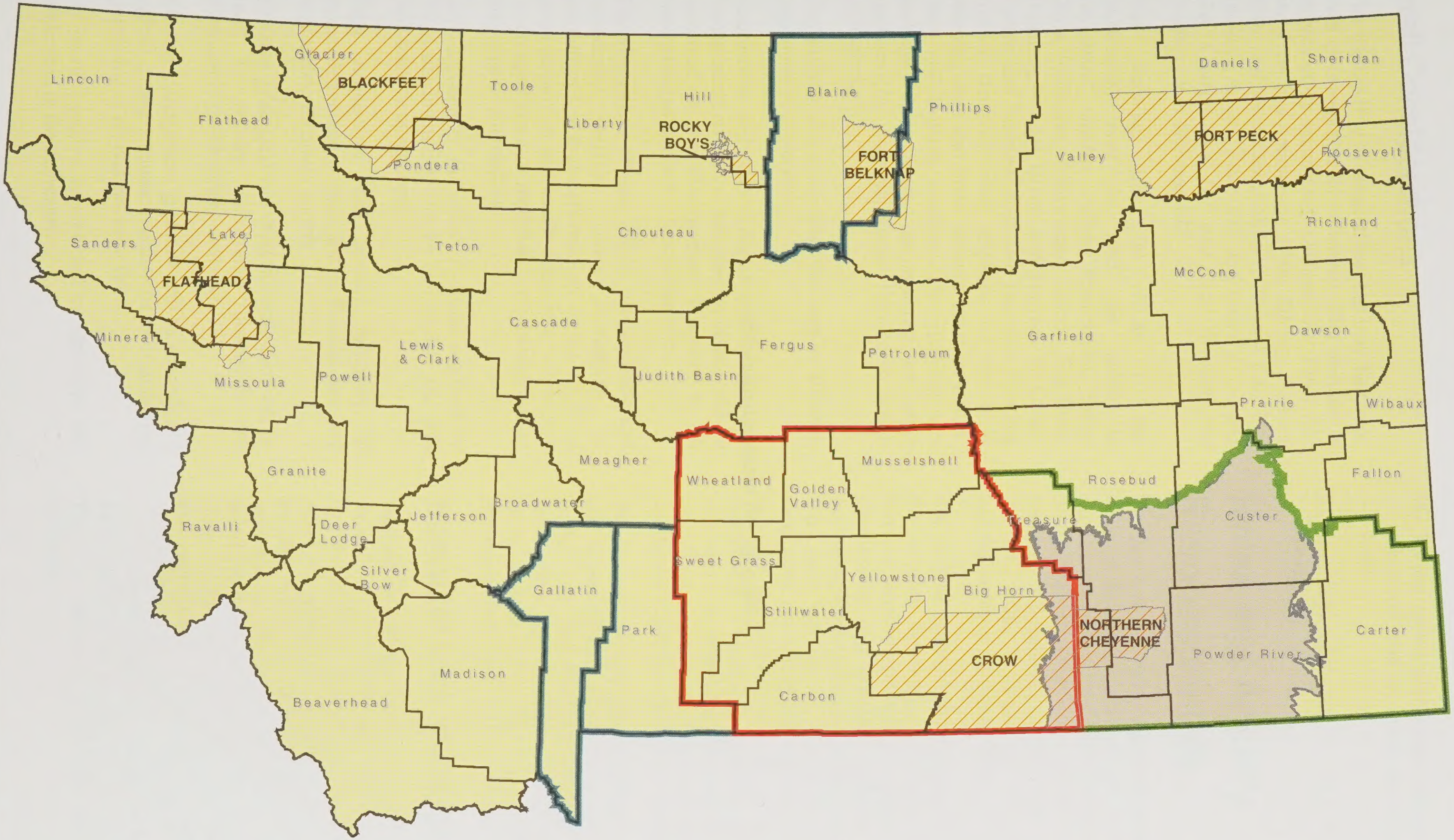
The State of Montana's purpose is to develop a program to address CBM exploration, development, production, and reclamation in Montana. The EIS, in part, responds to the stipulation and settlement agreement, dated June 19, 2000, resulting from a lawsuit brought by the Northern Plains Resource Council against the MBOGC in the Montana First Judicial District Court, Lewis and Clark County.

Planning Criteria

Introduction

Planning criteria are the constraints or ground rules used by the BLM to guide and direct the development of an RMP. Planning criteria guide the resource specialists in the collection and use of inventory information, and in analyzing the management situation, defining and analyzing the alternatives, and selecting the Preferred Alternative.

Map 1-1: Planning Areas


Lincoln
Glacier
BLACKFEET
Toole
Hill
Blaine
Phillips
Daniels
Sheridan
Flathead
Liberty
ROCKY BOY'S
FORT BELKNAP
Valley
FORT PECK
Roosevelt
Pondera
Sanders
Lake
Teton
Chouteau
Richland
FLATHEAD
McCone
Mineral
Cascade
Fergus
Garfield
Dawson
Lewis & Clark
Petroleum
Missoula
Powell
Judith Basin
Prairie
Wibaux
Meagher
Musselshell
Rosebud
Granite
Wheatland
Golden Valley
Fallon
Broadwater
Ravalli
Deer Lodge
Jefferson
Treasure
Custer
Sweet Grass
Silver Bow
Gallatin
Yellowstone
Big Horn
Stillwater
Park
NORTHERN CHEYENNE
Carter
CROW
Powder River
Madison
Beaverhead
Carbon

Legend

🟥 Billings RMP Area
🟩 Powder River RMP Area
▭ Special Consideration Counties
▨ Native American Reservations
▩ Powder River Geologic Basin

1:4,000,000

50 25 0 50 Miles

50,000 0 50,000 100,000 Meters

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Powder River Geologic Basin: 1:250,000 scale, USGS Professional Paper 1625a.

This page left blank intentionally.

Overall Considerations

1. The EIS/RMP will stand alone, but may be tiered from or incorporate by reference other documents as previously mentioned: *Oil and Gas Final EIS and Proposed Amendment of the Billings, Powder River and South Dakota RMPs, Wyodak Coal Bed Methane Project Final EIS*, and *Board of Oil and Gas Conservation Oil and Gas Drilling and Production in Montana EIS.*
2. The planning area for BLM is the BLM-administered oil and gas estate in Wheatland, Golden Valley, Musselshell, Sweet Grass, Stillwater, Yellowstone, Carbon, Big Horn, Treasure, Powder River, and portions of Carter, Custer, and Rosebud counties. The state planning area is statewide with emphasis on the BLM planning area and three isolated areas in Blaine, Park, and Gallatin counties. The planning area excludes those lands administered by other agencies (for example, Forest Service or Indian trust acreage).
3. The analysis area is any land that may be affected, regardless of ownership.
4. Alternatives will address the identified issues and management concerns. All other guidance will be presented in the Management Common to All Alternatives section of the Amendment/EIS.
5. The alternatives chosen will be economically and technically feasible. Those alternatives, or components of those alternatives, found not to be economically or technically feasible or viable will be dropped from or modified for consideration in the range of alternatives.
6. Any decision or mitigation measure required by the Amendment/EIS will be enforceable and will lend itself to monitoring.
7. Data acquisition will consist primarily of extrapolation and compilation of existing data and appropriate literature search.
8. Existing geological and fluid minerals data will be used to develop occurrence potentials and foreseeable development scenarios.
9. Current management guidance will be expanded to reflect recent resource regulations and guidelines pertaining to oil and gas operations.
10. A list of sensitive species will be identified and addressed in the document.
11. To the extent practicable, this document will be consistent with adjoining Forest Service lands and leases.
12. Decisions will comply with Rangeland Health Standards.

Roles and Agency Responsibilities

The development and preparation of this Final EIS has involved the participation of several federal and state agencies and sovereign Tribal Governments. Serving as co-leads for this effort have been the BLM and State of Montana. Cooperating agencies and partners include the BIA, DOE, EPA, and the Crow Tribe of Indians and the Northern Cheyenne Tribe.

The co-lead agencies were responsible for conducting the scoping meetings, preparing the development forecast, developing resource management alternatives, coordinating with industry, outlining the EIS format, evaluating impact analyses, reviewing technical reports and draft versions of the EIS, collecting public comments, consulting with tribal governments as well as other cooperators, and hiring and managing the consultants. The co-lead agencies have served in an oversight role throughout the process by coordinating the efforts of their respective staffs and departments to facilitate a coherent approach to CBM development.

The cooperating agencies and partner governments role was to participate in the review process of all technical reports and draft EIS/RMP portions. These agencies and Tribal governments also attended numerous meetings both public and project-specific to discuss and enumerate concerns and comments.

Bureau of Land Management

Drilling oil and gas exploration and production wells on lands where mineral rights are owned and controlled by the federal government must be conducted under an approved application for permit to drill (APD) issued by the BLM. In considering whether to approve applications for permit to drill and other lease activities, the BLM must consider the possible impacts from typical exploration and development activities, and cumulative environmental effects, to ensure compliance with NEPA. This FEIS was prepared to meet those requirements. As part of the permit process, BLM requires that adequate bond coverage is in place prior to approval of drilling activity on federal minerals.

The BLM's authority and decisions, related to oil and gas development in the planning area are limited to the agency's stewardship, resource conservation, and resource protection responsibilities for federal lands and minerals. As conservator of the federal surface and mineral estate, the BLM has responsibility for ensuring that the federal mineral resource is conserved (not wasted) and is developed in a safe and environmentally sound manner.

Much of the planning area contains lands known as "split estate." These are lands where the surface ownership is different from the mineral ownership. Management of federal oil and gas on these lands is somewhat different from management on lands where both surface and mineral ownership is federal. On split estate lands where surface ownership is private, and BLM administers the minerals, BLM places necessary restrictions and requirements on permitted activities and works in cooperation with the surface owner. BLM has established policies for the management of federal oil and gas resources under the following statutes: Federal Land Policy and Management Act (FLPMA), NEPA, National Historic Preservation Act (NHPA), and Endangered Species Act (ESA) (see BLM 1992, under "Split Estate" for more information).

Regulatory areas where the BLM has shared responsibilities or consultation requirements with other federal or state agencies include the following:

- Oil and gas drilling—FLPMA of 1976, 43 U.S.C. 1701 *et seq.* as amended (PL 94-579), and the Mineral Leasing Act of 1920, as amended, (PL 93-153). This is a shared responsibility with the Montana Board of Oil and Gas Conservation.
- Activities that would impact waters of the U.S. from the discharge of produced waters—BLM must comply with the Clean Water Act (CWA) as provided by Section 313 of the CWA, Section 313, 33 U.S.C. 1323. NPDES permits are issued by the State of Montana for actions involving the discharge of water from point sources on non-Indian lands. For actions involving the discharge of water from point sources, BLM works with MDEQ on private and public lands, and with EPA on Indian lands. BLM issues its approval only after State or EPA approval has been given.
- Activities that would impact waters of the U.S. from the placement of fill materials—The U.S. Army Corps of Engineers and BLM have shared responsibility in Montana for dredge and fill permits associated with CBM activities under Section 404, General Permit No. 404. This covers activities that impact waters of the U.S. as a result of placing fill in either waters of the U.S. or jurisdictional wetlands. See 33 CFR Part 320 and 40 CFR Part 230–Section 404(b)(1) Guidelines for the Specification or Disposal Sites for Dredged and Fill Materials.
- Special status species of plants or animals—ESA, U.S.C. 1531 *et seq.* This is a shared responsibility with the U.S. Fish and Wildlife Service (FWS) and Montana Fish, Wildlife, and Parks (MFWP).
- Cultural or historical resources—NHPA, 16 U.S.C. 470. BLM is required to consult with the SHPO and ACHP in accordance with regulations found at 36 CFR 800 or through alternative procedures as specified through Programmatic Agreements. The BLM in Montana operates under a National Programmatic Agreement and a state-wide Protocol to meet its requirements under the NHPA.
- Air Quality Impacts - FLPMA (43 U.S.C 1701 *et seq.*) and the Clean Air Act (CAA; 42 U.S.C 7401 *et seq.*) as amended, require that BLM assure the actions it conducts or authorizes (including oil and gas development) comply with all applicable local, state, tribal, and federal air quality laws, regulations, standards, increments, and implementation plans. Local, state, and tribal requirements may be more (but not less) stringent than federal requirements. The implementation of federal requirements is delegated to local, state, or tribal regulatory authorities, under EPA oversight.
- Surface water diversions, stream channel modifications, construction of new reservoirs, reservoir supply, or dam modifications to existing reservoirs, Montana Dam Safety Act, 85-15-207. This is a shared responsibility with the MDEQ Water Resources.
- Oil and gas well spacing—Memorandum of Understanding (MOU) between BLM and the Montana Board of Oil and Gas Conservation (MBOGC) concerning Oil and Gas Well Spacing/Well Location Jurisdiction, and the Montana Oil and Gas Conservation Act, Statute 82-11-201, Establishment of Well Spacing Units. This is a shared responsibility with the MBOGC.
- Consultation with Tribal Governments—Under Executive Order 13175, BLM will provide a meaningful opportunity for input by tribal officials where the action would have tribal implications. The Executive Order reflects the federal government's trust responsibility to federally recognized Indian tribes. Pursuant to this trust

responsibility, the federal government establishes regular and meaningful consultation and collaboration with tribes on a government-to-government basis when federal activities may affect Indian tribes.

Protecting the U.S. Government and Indian lessors from loss of royalty as a result of oil and gas drainage is a prime responsibility of BLM. Under the terms of both federal and Indian leases, the lessee has the obligation to protect the leased land from drainage by drilling and producing any well(s) that is necessary to protect the lease from drainage or in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM's Drainage Protection Guidelines. Federal leases determined to be in danger of drainage are subject to geologic, engineering, and economic analyses in order to define the presence and magnitude of drained reserves.

The geologic analysis is a comprehensive examination of the lithologic, structural, and stratigraphic components of the subject reservoir to determine whether drainage is geologically possible. The subject reservoir is mapped to define its limits and physical characteristics using all available data. Differences between the BLM's independent geologic analysis and the lessee's geologic analysis, if submitted, are discussed and reconciled in the final report. The report describes in detail how the geology affects drainage in the subject area.

The reservoir engineering/economic analysis is the final examination of the reservoir performance, production history, and economic determinants to determine whether drainage is occurring or has occurred and whether an economic protection well could have been drilled. The BLM would evaluate any data submitted by the lessee and resolve or explain any significant differences. The BLM analyses will determine the measures necessary to mitigate the effects of drainage of hydrocarbons ranging from a mineral owner's demand to drill a protection well to holding the lessee liable for the value of drained resource.

Exploration and production wastes include produced water, oilfield production fluids (including drilling muds and fracture fluid flowback), crude oil and condensate, and contaminated soils. Produced water, drilling muds, and fracture fluids are generally authorized for disposal by underground injection in Class II Underground Injection Control (UIC) wells under regulations of the MBOGC, or the EPA on tribal lands. Small, uneconomical quantities of crude oil and/or condensate, when wasted, are typically collected and sold to a waste oil recycler. Soils contaminated with exploration and production wastes can be disposed in a Subtitle D (nonhazardous) landfill, or may be treated onsite with the approval of the appropriate regulatory authority and surface lessee. Drilling mud is exempt from both the Hazardous Waste Program (ARM 16.44.304(2)(c), and the Montana Hazardous Waste Act. Drilling mud that contains less than 15,000 total dissolved solids (TDS) can be disposed of onsite with the landowner's permission.

State of Montana

State agencies that have authority over oil and gas activities include the DNRC and MDEQ. The DNRC has two divisions involved in oil and gas development. These divisions are the Oil and Gas Conservation Division—also known as the MBOGC, and the Trust Land Management Division (TLMD). The MBOGC is the lead agency for regulating oil and gas development in Montana. The Board's responsibilities include issuing drilling permits, classifying wells, establishing well spacing units and land pooling orders, inspecting drilling, production, and seismic operations, investigating complaints, conducting engineering studies, establishing bonding requirements, and collecting and maintaining well data and production information. It also administers the federal Underground Injection Control Program for Class II injection or disposal wells in Montana to protect underground sources of drinking water.

Additional regulatory areas where the State of Montana has responsibility are managed by state agencies that have jurisdiction over some aspects of the oil and gas drilling and production. These agencies are the DNRC and MDEQ. The MFWP and the SHPO serve in advisory roles though they have no regulatory authority. Each of these agency's roles and responsibilities are discussed below.

Department of Natural Resources and Conservation

As a result of the 1995 legislative Natural Resource Agency reorganization, the "new" DNRC was formed. It combined the majority of programs from the old Departments of State Lands and Natural Resources and Conservation. Programs of the reorganized DNRC include: the MBOGC, TLMD, Reserved Water Rights Compact Commission, Forestry Division, Conservation and Resource Development Division, and Water Resources Division.

The DNRC is responsible for sustaining and improving the benefits derived from water, soil, and rangeland, managing the State of Montana's trust land resources, protecting Montana's natural resources through regulation and partnerships with federal, state, and local agencies, promoting conservation of oil and gas and preventing their waste through the regulation of exploration and production, and managing and assisting in the management of several grant and loan programs. Sections addressing the responsibilities of the MBOGC, TLMD, and Water Resources Division as they pertain to oil and gas development follow this discussion.

Montana Board of Oil and Gas Conservation

The MBOGC is the lead state agency for regulating oil and gas development in Montana. It is a quasi-judicial body that is attached to the DNRC for administrative purposes. The law is quite specific regarding some of the MBOGC's makeup:

> *The board consists of seven members, three of whom shall be from the oil and gas industry and have had at least 3 years experience in the production of oil and gas, and two of whom shall be landowners residing in oil- or gas-producing counties of the state but not actively associated with the oil and gas industry, but one of the two landowners shall be one who owns the mineral rights with the surface and the other shall be one who does not own the mineral rights (MCA Section 2-15-3303).*

Additionally, one must be an attorney. All members are appointed to 4-year terms by the governor—four members (the majority) when he or she takes office, the others, 2 years later.

MBOGC's regulatory action serves three primary purposes: (1) to prevent waste of oil and gas resources, (2) to conserve oil and gas by encouraging maximum efficient recovery of the resource, and (3) to protect the correlative rights of the mineral owners, that is, the right of each owner to recover its fair share of the oil and gas underlying its lands. MBOGC also seeks to prevent oil and gas operations from harming nearby land or underground resources. Since 1993, MBOGC has performed the certification required for companies to receive tax incentives available for horizontal wells and enhanced recovery projects.

The MBOGC was established in 1953 with the passage of the Montana Oil and Gas Conservation Act (82-11-101, *et seq*., Montana Code Annotated [MCA]). Under Montana law, no oil or gas exploration, development, production, or disposal well may be drilled until a bond has been posted and MBOGC issues a drilling permit. This requirement applies to all private, state, and most federal lands, but excludes proposals on allotted or tribal minerals. In November 1987, MBOGC and the BLM signed a cooperative agreement to coordinate their decisions regarding permits to drill. Under this agreement, MBOGC accepts for the record all permits to drill for federal oil and gas minerals in Montana.

The powers and duties of MBOGC in regulating oil and gas activities are defined in 82-11-111, MCA. MBOGC is charged with determining whether a waste of resources is existing or imminent. Based on their determination, MBOGC can take measures to prevent contamination of or damage to surrounding land and underground strata caused by drilling operations and production. These measures include, but are not limited to, regulating the disposal of produced salt water and the disposal of oil field wastes. The MBOGC regulations are located in Title 36, Chapter 22, of the *Administrative Rules of Montana* (ARM).

In 1989, the MBOGC prepared a programmatic EIS to assist in determining how to incorporate any necessary environmental review into its rules and permitting process in an effort to come into compliance with MEPA. The programmatic EIS presented various alternatives for addressing environmental reviews during the permitting process. From these alternatives, MBOGC has adopted an environmental review process for permitting wells.

In conducting environmental reviews for new permits, MBOGC works with other state agencies that may become involved in the process. This 2003 FEIS was prepared to assist in the review process and to meet the requirements of both MEPA and NEPA for CBM development.

Trust Land Management Division

The TLMD is responsible for managing the surface and mineral resources of forest, grazing, agricultural, and other classified state trust lands to produce revenue for the benefit of Montana's public schools and other endowed institutions. The TLMD manages more than 5.1 million acres of surface acreage and in excess of 6.3 million acres of mineral acreage.

The TLMD is divided into four bureaus: the Minerals Management Bureau, Agriculture and Grazing Management Bureau, Forest Management Bureau, and Special Uses Management Bureau.

The TLMD administers mineral leases on its school trust land mineral estate and, as a courtesy, other state agency's mineral estate. Leasing procedures will not change because of management alternatives. It should be noted that the TLMD is responsible for management of surface and mineral acreage, while some other agencies perform in more of a regulatory role. The TLMD must comply with MEPA. MEPA is required for state-proposed actions. The process is implemented both at the leasing stage and for proposed plans of operation (drilling plans). For plans of operation, it is conducted by the area offices. Information, management restrictions, and environmental documents are then forwarded to the Minerals Management Bureau for approval. The Minerals Management Bureau then notifies operators of their decision to approve or disapprove.

Water Resources Division

The Water Resources Division is responsible for various programs coupled with the development, uses, and protection of Montana's water. It oversees the state-owned water resource projects, water rights, and water reservoirs. Its activities include centralized water rights record keeping, state water planning, floodplain management, dam safety, drought planning, and interstate coordination of water issues. The division provides administrative support to the Board of Water Well Contractors, a board that licenses well drillers and establishes minimum well construction standards.

Through the state water planning process, the division also guides the development of the state water plan and statewide water policies and laws. The state water plan is a progressive, collaborative, and citizen-based process for improving the management of the state's water resources. Other responsibilities include staffing the Drought Advisory Committee and coordinating drought responses, assisting in the planning and developing of water storage projects, analyzing the effects of proposed new water uses on existing water rights, protecting Montana's water from interstate, regional, and international threats, responding to federal laws and actions that potentially affect Montana's water, and providing water resource education to Montanans through the Montana Watercourse.

The division recently helped draft the *Powder River Basin Controlled Groundwater Area Final Order* that was signed by the DNRC director on December 15, 1999. A copy of the order is contained in Appendix A of the Water Resources Technical Report (ALL 2001b) prepared for this EIS. The order is intended to protect existing water users from impacts of CBM development. The order recommends monitoring and reporting standards, establishes a Technical Advisory Committee, and calls for the implementation of mitigation agreements between surface owners and CBM operators. The Technical Advisory Committee makes recommendations to the MBOGC regarding specific site monitoring and reporting requirements. The MBOGC has enforcement authority over monitoring and reporting requirements for continuing CBM operations as established in the Boards' Order 99-99, *Establishing CBM Operating Standards*.

Montana Department of Environmental Quality

MDEQ has two divisions directly or indirectly involved with oil and gas development: Permitting and Compliance and Planning, Prevention, and Assistance. The following are brief descriptions of the role of each division:

- The Permitting and Compliance Division is in charge of permit issuance and compliance monitoring for projects relating to air, water, public water supplies, solid and hazardous waste, subdivisions, motor vehicle recycling, open cut, hard rock, and coal and uranium mines, and applicable facilities under the Major Facility Siting Act. Nearly all permits and authorizations issued by MDEQ are handled through this division.

- The Planning, Prevention, and Assistance Division is involved with planning, policy, and standards development relating to air quality State Implementation Plans, water quality, non-point source management, groundwater protection, and solid waste management.

MDEQ administers MEPA along with Montana's Hazardous Waste Management Act, Clean Air Act, the Solid Waste Management Act, Water Quality Act, Water Quality Discharge Permits, Major Facility Siting Act, and the Montana Pollutant Discharge Elimination System. MDEQ is responsible for investigating the environmental impacts associated with continued oil and gas activities in accordance with MEPA and the EIS process.

MDEQ has delegated responsibility under the Federal Clean Water Act (P.L. 92-500) and Montana Water Quality Act (75-5-101, *et seq.*) to monitor and assess the quality of Montana surface waters for toxic and conventional pollutants, to prepare plans to control pollution, to assess water quality conditions and trends, to report them to the EPA and Congress, and to identify impaired or threatened stream segments and lakes. Furthermore, the state must provide a program for the prevention, abatement, and control of water pollution. Recent amendments to the Montana Water Quality Act (MCA 75-5-702, effective May 1997) require the Department to consider all currently available data when making water quality assessments, including information or data obtained from federal, state, and local agencies, private entities, or individuals with an interest in water quality protection.

The DEQ also administers the MPDES Storm Water Discharge Permitting Program. Owners/operators of Coal Bed Methane exploration, production, processing, or treatment operations, or of associated transmission facilities, are exempt from needing coverage under the DEQ's MPDES "*General Permit for Storm Water Discharges Associated with Mining and with Oil & Gas Activities.*" The permit is contingent on the discharge being composed entirely of storm water that has not come into contact with, or been contaminated by contact with, any overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site.

Construction activities associated with CBM operations are subject to potentially requiring coverage under the DEQ's MPDES "*General Permit for Storm Water Discharges Associated with Construction Activity.*" Permit coverage is obtained by submitting a Notice of Intent (NOI) package, including a completed NOI form, Storm Water Pollution Prevention Plan, and fee before the proposed construction start date. The determination of whether MPDES General Permit coverage for construction is required, or if more than one NOI is necessary under the General Permit, is based on the discharge(s) of storm water runoff to surface water, the acreage of disturbance(s) resulting from construction activity, proximity of construction-related disturbance to surface water, overall time period of construction, contractor(s) performing the construction activity, and number of drainage basins or receiving waterbodies.

When areas with construction-related disturbance have been stabilized, permit coverage under the General Permit may be terminated. With respect to the acreage of total construction-related disturbance triggering the need for permit coverage under this General Permit, new EPA Phase II requirements will be lowering the current 5-acre threshold to 1 acre. This Phase II requirement is built into the current June 8, 2002, General Permit, and should become effective March 2003 upon incorporation of Phase II requirements into the Administrative Rules of Montana.

MDEQ–Air & Waste Management Bureau (AWM) also has delegated responsibilities under the federal Clean Air Act (42 U.S.C. 7401, *et seq.*) that requires the State to operate an approved ambient air quality monitoring network for the purpose of evaluating compliance with the National Ambient Air Quality Standards (NAAQS), to report air quality monitoring information to the EPA, and to prepare plans for controlling air pollution. Additionally, the state is required under the Clean Air Act of Montana (75-2-101, *et seq.*) to provide a coordinated statewide program of air pollution prevention, abatement, and control. When actual locations and operational requirements for gas compression facilities (CBM development) are determined, permit applications would be submitted to MDEQ-AWM. At that time, additional site-specific, air quality analyses, such as the Best Available Control Technology (BACT) analysis or Prevention of Significant Deterioration (PSD) increment analysis, may be performed.

Montana Fish, Wildlife, and Parks

MFWP is responsible for the conservation and management of the fish, wildlife, parks, and recreational resources of Montana. This department advises other agencies of wildlife concerns.

State Historic Preservation Office

Under the National Historic Preservation Act of 1966 as amended, states were given certain responsibilities. These responsibilities have been assigned to the SHPO, which is a program within the Montana Historical Society. The SHPO provides assistance in the following areas: the identification and listing of properties on the National Register of Historic Places (NRHP), historic building maintenance and rehabilitation, archaeological sites and research, tax incentives for preservation, community surveys, the PLACES program (Peoples, Lands, and Cultural Environments), National Register Signs, local government and grant assistance, preservation education, and state and federal agency responsibilities. The SHPO provides information regarding the procedures that state and federal agencies must follow to consider historic and archaeological resources in their activities and programs.

Tribal Governments

The following two sections address the roles and responsibilities of the Crow Tribe of Indians and the Northern Cheyenne Tribe as they relate to the development of CBM on and around their reservations.

Crow Tribe of Indians

The Crow Tribe's territorial jurisdiction as administered by the General Council extends to all lands within the exterior boundaries of the Crow Indian Reservation. The Crow Tribal Court has civil jurisdiction over all persons who reside, enter, or transact business within the reservation including non-Indian activities on fee lands within the reservation that may directly impact reservation lands or tribal welfare. The Crow Constitution tasks the Executive Branch with management and development of natural resources pending final approval of the Legislative Branch for any mineral agreement.

Within the context of resource utilization, the Crow Executive Branch delegates mineral development through the Tribe's Natural Resources and Environmental Departments. These departments may establish codes and set standards under federal statutes or inherent tribal authority for regulating activities that affect the tribal resources and environmental conditions. The Crow Tribe currently does not have any specific environmental laws or codes in place, but has the following ordinances and codes related to mineral development:

- Coal Exploration and Mining Ordinance 1998
- Land Use Zoning Ordinance 1995
- Crow Tribe Uniform Commercial Code 1998
- Tribal Employment Rights Ordinance 1979

The tribe has developed Draft Water Quality Standards and Draft Air Quality Standards, which will govern all development actions once these requirements are officially enacted. All mineral leasing and permitting for development, exploration, and Right-of-Way (ROW) authorization on Tribal or Allotted lands is subject to 25 CFR regulations enforced through BIA and BLM procedures.

The 1984 EPA *Indian Policy* acknowledges tribal governments as the primary parties for setting standards, making environmental policy decisions, and managing reservation programs consistent with agency standards and regulations. The EPA will assist interested tribal governments in developing programs and in assuming regulatory responsibility for reservation lands. Until the Crow Tribe is granted formal primacy for these delegated programs, the EPA will retain management and enforcement responsibilities.

The Crow Tribe's Constitution (July 2001) specifically provides the Executive Branch with detailed power for Eminent Domain and ROW. While it is commonly established that Indian Tribes hold fundamental control for eminent domain and condemnation of lands, the Crow Tribe purposely named such powers in their constitution to provide notice to the public of the Tribe's objective to use this power. The logic behind purposely naming its power is to bolster its plan to develop mineral resources in the very near future. (Crow Tribe 2002)

The Northern Cheyenne Tribe

The Northern Cheyenne Tribal government is structured by a Constitution and By-laws endorsed by the tribe and approved by the Secretary of the Interior in 1936. The Northern Cheyenne amended their Constitution in 1960 and in 1996 to address changes in their governmental structure. The Northern Cheyenne Government is organized into three branches, an executive branch, a legislative branch, and a judicial branch.

The Executive Branch oversees a series of boards, commissions and programs, some of which deal with the regulation and control of natural resources. Through these boards and programs, the Executive Branch administers federal contracts and grants, and conforms to federal standards for environmental quality.

The Legislative Branch (Tribal Council) has the power to negotiate with the federal, state, and local governments, approve or prevent the sale, disposition, or lease of tribal lands including oil and gas, eminent domain, and protect and preserve tribal natural resources. The Tribal Council also has economic powers such as the right to engage in any business that might further the economic interests of the tribe or to carry out other economic activities that are not inconsistent with their constitution.

The Judicial Branch has the power to review the constitutionality of ordinances adopted by the Tribal Council, including mineral leases.

The Northern Cheyenne Tribe has redesignated their lands under the Clean Air Act (CAA) as a Prevention of Significant Deterioration (PSD) Class I area. The allowable incremental impacts within PSD Class I areas are very limited. The CAA directs the EPA to promulgate the Tribal Authority Rule, establishing tribal jurisdiction over air emission sources on both trust and fee lands within the exterior boundaries of tribal lands. The Northern Cheyenne are currently in the process of developing a tribal Implementation Plan, to submit a "Treatment as State" application to the EPA. Requesting that the Tribe be treated in the same manner as a state under the CAA will allow them to participate in Section 105 grants and have formal recognition as an affected "state" when permits are written for sources within 50 miles of tribal lands.

The Northern Cheyenne have a formal water management policy governing the management of tribal waters resources on the reservation. The Tribe has yet to appoint a Water Resources Board or Administrator to oversee the implementation of their code and permitting process to account for water resources. However, once enacted the Water Code will be enforceable for all activities affecting tribal waters on the reservation. The Native Americans section in Chapter 3 contains a full explanation of the Northern Cheyenne Water Code.

The Northern Cheyenne have adopted Surface Water Quality Standards, to protect current uses and water quality through non-degradation provisions. The Tribe has adopted these standards and has submitted them to the EPA for review. In addition, the Tribe has submitted an application under Section 518 of the CWA for "Treatment as a State". A complete explanation of the Draft Standards can be found in the Northern Cheyenne portion of the Native American section of Chapter 3.

Other Federal Agencies

Environmental Protection Agency

Under Section 402 of the CWA, 33 U.S.C. Section 1342, and 40 CFR Parts 122-125, EPA has authorized the states of Montana and Wyoming to issue National Pollutant Discharge Elimination System (NPDES) permits for discharges of pollutants from point sources into waters of the U.S. located in Montana and Wyoming, excluding Indian country as defined at 18 U.S.C. 1151. EPA retains an oversight and partnership role in state NPDES programs. As described in 40 CFR Part 123, Subpart C, EPA reviews proposed state NPDES permits for compliance with CWA requirements. For discharges in **Indian country** (a term that is defined in 40 CFR Section 122), EPA has direct implementation authority for issuing NPDES permits. Under Section 402 of the CWA, EPA is preparing a technical and economic analysis to assess disposal options for water that is produced as part of the CBM extraction process. The analysis will support the determination of effluent limitations that represent economically achievable BACT for CBM-produced waters. The following sections of the CWA also apply:

- **CWA Section 401, 33 U.S.C. Section 1341, and 40 CFR Part 121.** These provisions describe EPA's role in addressing certain discharges in one state that may affect the quality of water within any other state. The Northern Cheyenne Tribe has applied for "treatment as a state" designation under Section 518 of the CWA.
- **CWA Section 518, 33 U.S.C. Section 1377, and 40 CFR Part 131.8.** In June of 1999, the Crow Tribe submitted a draft application to EPA to administer a water quality standards program. The Northern Cheyenne Tribe submitted a draft application to EPA to administer water quality standards in January of 2001 and anticipates submitting a final application to EPA later this year.
- **CWA Section 303(d), 33 U.S.C. Section 1313(d) and 40 CFR Part 130.** These provisions require states to identify waters that need Total Maximum Daily Loads (TMDLs) standards and to establish TMDLs for them, with an oversight and partnership role for EPA. Currently, EPA and the State of Montana are subject to a court order that prohibits NPDES permits for new or increased discharges into any water body that has been listed as needing any TMDLs standards until all necessary TMDLs standards are established for a particular water quality limited segment (U.S. District Court 2000). The Tongue River, the Powder River, and the Little Powder River have been included on the list of streams that need TMDLs.

The Safe Drinking Water Act (SDWA) also applies to CBM projects, specifically, 42 U.S.C. Section 300f, *et seq*., particularly 42 U.S.C. Sections 1421 *et seq*., and 40 CFR Parts 144-147 regarding underground injection control (UIC). Should produced water from CBM operations be injected into the ground, UIC permits may be necessary. EPA and the states administer UIC programs to protect underground sources of drinking water. EPA administers the programs for Class V UIC wells in the State of Montana and for all classes of UIC wells on Indian lands in Montana and Wyoming. EPA has approved Wyoming's program for administering the UIC program for all five classes of UIC wells and Montana's program for administering the UIC program for Class II wells, and EPA retains an oversight and partnership role with these states for these programs. EPA's approvals of the states' authorities to administer these programs do not extend to Indian country.

EPA also administers Section 309 of the CAA, 42 U.S.C. Section 7609. This provision calls for EPA to review and comment on the environmental impact of major federal actions to which the NEPA, 42 U.S.C. Section 4332(2)(C), applies.

Bureau of Indian Affairs

BIA is responsible for the approval of any lease, agreement, permit, or document that could encumber lands and minerals owned by either tribes or allottees. Title to these resources is held by the U.S. Government in trust. As such, agreements or arrangements, involving the trust assets, that tribes or allottees make are not binding until they have been approved by the trustee. The agency that has been authorized to act as the trustee to keep the resources from being harmed or alienated is the BIA.

Within the Crow Reservation, there are approximately 1,497,000 acres of trust land out of the 2,282,000 total acres within the boundary. The Northern Cheyenne Reservation is composed of 444,000 acres within the external boundary. Of that amount, 442,000 acres are held in trust. (Land Titles and Records Office, BIA, Rocky Mountain Regional Office 1994).

The BIA intends to adopt the EIS for future decisions it may have to make on hydrocarbon exploration and production with an emphasis on CBM involving trust minerals. Such decisions relate to approval of leases, agreements, easements and/or ROW associated with exploration and production. The BIA will rely on the reasonably foreseeable development estimates and cumulative impact analysis anticipated for the region. The science and analysis components of the document may be incorporated in future BIA NEPA compliance documents.

U.S. Department of Energy

Fossil Energy

The Office of Fossil Energy is charged with enhancing the U.S.' economic and energy security through the following actions:

- Managing and performing energy-related research that promotes the efficient and environmentally sound production and use of fossil fuels.
- Partnering with industry and others to advance clean and efficient fossil energy technologies toward commercialization.
- Managing the Strategic Petroleum Reserve to reduce vulnerability to economic, national security, and foreign policy consequences of supply interruptions.
- Supporting the development of information and policy options that benefit the public by ensuring access to adequate supplies of affordable and clean energy.

Office of Fossil Energy—Oil and Gas Program

The primary mission is to assure that fossil energy resources can meet increasing demand for affordable energy without compromising the quality of life for future generations. This program has been at the forefront of research to advance fossil energy exploration, supply, and end-use technologies.

The Oil and Gas programs include the following:

- **Natural Gas Technologies.** Pursuing advances in exploration and production, infrastructure reliability, and technologies including fuel cells and gas turbines systems.
- **Oil Technology.** Enhancing the efficiency of oil exploration, recovery, and processing while improving environmental quality.
- **Gas Energy Systems Dynamics.** Activities will lead to the development of the next generation of gas turbines, fuel cells, coupled turbine-fuel cell systems, and reciprocating engines, and lay the foundation for new gas utilization technologies.
- **Ultra Clean Fuels.** Developing enabling science for the production of ultra-clean and affordable fuels from fossil resources for high-efficiency transportation systems.

Agency Permits and Reviews

Table 1-1 shows the agencies and applicable permits or reviews potentially required for oil and gas operations on federal, state, and private lands. Table 1-2 is a matrix showing the permitable activity and the responsible agency issuing a permit or approval.

TABLE 1-1
APPLICABLE PERMITS/REVIEWS FOR OIL AND GAS DEVELOPMENT ACTIVITIES

Agency	Review/Permit/Approval
Bureau of Land Management (BLM)	Approval of APDs and Sundry Notices (SNs) on federal leases. Approval or issuance of ROW on federal surface. Approval of Communitization Agreements and Federal Unit Agreements. Native American Graves Protection and Repatriation Act (NAGPRA) regulates the treatment of unmarked Indian graves and human skeletal remains. NAGPRA is implemented by regulations found at 43 CFR Part 10. The National Register of Historic Places (NRHP) is the official list of the Nation's cultural resources worthy of preservation. Properties listed in the National Register include districts, sites, buildings, structures, and objects that are significant in American History, architecture, archeology, engineering, and culture. These resources contribute to an understanding of the historical and cultural foundations of the Nation. The Advisory Council of Historic Preservation (ACHP), an independent Federal Agency, was established by the NHRP. The ACHP, through regulations found at 36 CFR 800, has a specific role to advise Federal agencies regarding the effects of their actions on Historic Properties. Historic properties are by definition, cultural resources that are eligible to or listed on the NRHP. American Indian Religious Freedom Act (AIRFA) and Executive Order 13007 acknowledges the rights of Native Americans to practice traditional religion, have access to and protect religious sites, and possess sacred objects.
U.S. Army Corps of Engineers (COE)	Section 404 of the Clean Water Act—regulates the discharge of dredged or fill material into waters of the U.S.; Section 404 permit.
U.S. Fish and Wildlife Service (FWS)	Review under ESA/Biological Opinion.

TABLE 1-1
APPLICABLE PERMITS/REVIEWS FOR OIL AND GAS DEVELOPMENT ACTIVITIES

Agency	Review/Permit/Approval
U.S. Environmental Protection Agency (EPA)	Regulates Underground Injection Control (UIC) Class V injection program/UIC Permit.
	Regulates all classes of underground injection wells and all point source discharge to streams for any source located in Indian country.
	ESA review for NPDES permits, TMDLs and Water Quality Standards (WQS) on state and tribal lands.
	Clean Air Act (CAA)—(42 U.S.C. 7401, *et seq.*) Air quality permitting for air pollutant emitting sources within the exterior boundaries of tribal lands.
	404 enforcement under the CWA for dredge and fill activities.
	401 Discharge certification under the CWA on tribal lands and certain discharges in one state that may affect the quality of water within any other state.
	518 under the CWA for approval or disapproval of Tribal Water Quality Standards.
	Section 303(d) of the CWA regarding EPA's oversight and partnership role with states to identify streams that do not meet the CWA objectives by establishing TMDLs for such streams.
Montana Department of Environmental Quality (MDEQ)	Administers MEPA (75-1-101, MCA).
	Clean Air Act of Montana (75-2-101 *et seq.*, MCA)(ARM 17.8). Air quality permitting for air pollutants emitting sources outside the exterior boundaries of tribal lands.
	Resource Conservation and Recovery Act (RCRA) Waste Disposal—Hazardous Waste Management Act (75-10-401, Montana Codes Annotated [MCA]) (Administrative Rules of Montana [ARM] 17.53.101).
	Solid Waste Management Act (75-10-201, MCA) (ARM 17.50.501).
	Water Quality Act (75-5-401 through 405, MCA).
	Montana Surface WQS (ARM 17.30.601 *et seq.*).
	401 Discharge Certification under the CWA.
	Montana Nondegradation Rules (ARM 17.30.701 *et seq.*).
	Montana Pollutant Discharge Elimination System (MPDES) (ARM 17.30.1201 – 1426).
	Certificate of environmental compatibility—Major Facility Siting Act (75-20-101, MCA).
	Montana Groundwater Pollution Control System (MGWPCS) (ARM 17.30.100 *et seq.*).
State Historic Preservation Office (SHPO)	Review under the National Historic Preservation Act (NHPA) regarding identification and evaluation of cultural/historic resources.

TABLE 1-1
APPLICABLE PERMITS/REVIEWS FOR OIL AND GAS DEVELOPMENT ACTIVITIES

Agency	Review/Permit/Approval
County Weed Districts	Review for control and prevention of noxious weed infestations under the Noxious Weed Control Law (7-22-2101, MCA).
Local Conservation District	Montana Natural Streambed and Land Preservation Act (310 Permit).
Montana Department of Natural Resources and Conservation (DNRC)	See descriptions for individual bureaus and divisions listed below.
Trust Land Management Division (TLMD)	Approval of activities on state trust surface and mineral estate (subsurface) lands; issuing land use licenses, easements, and mineral leases; conducting land exchanges; manages grazing permits.
Minerals Management Bureau (MMB)	Responsible for leasing, permitting, and managing mineral leasing program.
Water Resources Division, Water Rights Bureau	Permit to allow beneficial use of groundwater and surface water. (85-2-310 to 312, MCA).
Montana Board of Oil and Gas Commission (MBOGC)	Approval of state drilling permits on state and private leases (APDs). (ARM 36.22) (82-11-111, MCA).
	Oversee UIC program for Class II wells (ARM 36.22.1401)(82-11-101, MCA).
	RCRA-exempt Solid Waste Disposal (ARM 36.22.1105).
	Surface Restoration (ARM 36.22.1307).

TABLE 1-2
PERMITABLE ACTIVITIES FOR CBM DEVELOPMENT

Permitable Activity	Federal Agencies	State Agencies
Drilling on a Federal Lease	**BLM** - Approval of APDs and SNs on Federal leases. (3162.3-1, Onshore Oil and Gas order No. 1) **U.S. Army COE** – 404 General permit if access roads cross perennial streams **USFWS** – Review of EA/EIS for Biological Opinion	**MBOGC** – Federal APD (for record purposes only) **SHPO** - Review under the National Historic Preservation Act (NHPA) regarding protection of cultural/historic resources.
Drilling on a State or Fee Lease		**MBOGC** – Approval of state drilling permits on state and private leases (APDs). (ARM 36.22) (82-11-111, MCA) **MBOGC** – Checklist EA approval **DEQ** - Administers MEPA (75-1-101, MCA) for site-specific EISs **TLMD** - Approval of activities on state trust surface and mineral estate (subsurface) lands **SHPO** - Review under the NHPA
Right-of-Ways (ROW)	**BLM** – Approval of ROWs on BLM administered surface lands	**DNRC/TLMD** – Approval of ROWs on Trust lands **Surface Owner** – Agreement of ROWs under Surface Owner Agreement **SHPO** - Review under the NHPA
Building a Gas Compressor Station on a Federal lease	**EPA** - Clean Air Act (CAA)—(42 U.S.C. 7401, *et seq.*) Air Quality Permits within the exterior boundaries of tribal lands.	**SHPO** - Review under the NHPA
Building a Gas Compressor Station on a State or Fee Lease		**DEQ** – Clean Air Act of Montana (75-2-101 *et seq.*, MCA)(ARM 17.8). Air Quality Permitting outside the exterior boundaries of tribal lands. **SHPO** - Review under the NHPA
Discharge of Dredged or Fill Material	**U.S. Army COE** - discharge of dredged or fill material into waters of the U.S.; Section 404 permit.	**DEQ** – MPDES General Discharge permit
Hazardous Waste Disposal		**DEQ** - Resource Conservation and Recovery Act (RCRA) Waste Disposal—Hazardous Waste Management Act (75-10-401, Montana Codes Annotated [MCA]) (Administrative Rules of Montana [ARM] 17.53.101).
Drilling Mud and other Solid Waste Disposal		**MBOGC** – RCRA-exempt Solid Waste Disposal (ARM 36.22.1105). **DEQ** - Solid Waste Management Act (75-10-201, MCA) (ARM 17.50.501).

TABLE 1-2
PERMITABLE ACTIVITIES FOR CBM DEVELOPMENT

Permitable Activity	Federal Agencies	State Agencies
Disposal of Produced Water		
Injection	**EPA** - Underground Injection Control (UIC) Class V Permits for wells on both Federal and State lands. UIC Class II and V Permits for Indian Reservations **BLM** - Onshore Order No. 7 Permit	**MBOGC** - Oversee UIC program for Class II wells (ARM 36.22.1401)(82-11-101, MCA).
Infiltration Pit	**BLM** - Onshore Order No. 7 Permit	**MBOGC** –Infiltration Pit Permit for the construction and operation **DEQ** - Montana Pollutant Discharge Elimination System (MPDES) (ARM 17.30.1301 – 1426).
Surface Discharge	**EPA** - Review for NPDES permits, on state and tribal lands and 401 Discharge Certification under the CWA on tribal lands and certain discharges in one state that may affect the quality of water within any other state.	**DEQ** - 401 Discharge Certification under the CWA & Montana Nondegradation Rules (ARM 17.30.701 *et seq.*). **DEQ** - Montana Pollutant Discharge Elimination System (MPDES) (ARM 17.30.1301 – 1426).
Treatment & Discharge		**DEQ** - 401 Discharge Certification under the CWA & Montana Nondegradation Rules (ARM 17.30.701 *et seq.*).
Beneficial Use		**MDNRC/WRD/WRB** - Permit to allow beneficial use of groundwater and surface water. (85-2-310 to 312, MCA).

Issues

This section presents planning issues identified through the public scoping process and the BLM and state planning activities. The issues raised were in relation to CBM development. These issues are addressed in the analysis of impacts in Chapter 4.

Air Quality and Climate

- Reduction in visibility occurring to the Northern Cheyenne Indian Reservation PSD Class I airshed from emissions
- Air quality impacts from oil- and gas-related activities
- Dust and emissions associated with road and drill pad construction, drilling operations, production, and compression
- Creation or release of harmful gases (hydrogen sulfide) and venting
- Consistency with the air quality model currently being developed for the Powder River EIS through the BLM Buffalo Field Office, Wyoming
- Release of greenhouse gases and effect on global warming
- Changes in ambient air quality and how this relates to objectives for minimizing regional haze based on the "Regional Haze Rule"
- Changes in climate associated with CBM development

Cultural Resources

- Avoidance of direct and indirect disturbances to cultural resources may precipitate the development of targeted inventory and evaluation strategies in the planning stages of field development
- Impacts on the qualities of a cultural resource site affecting its eligibility for the NRHP
- Increased access for oil and gas exploration and development may result in inadvertent, indirect, and cumulative effects to cultural resources
- Identification of specific districts or localities in which oil and gas development may be incompatible with existing cultural values
- Identification of areas of critical environmental concern

Geology and Minerals

- Re-establish hydrologic balance and functionality after CBM development so that adjacent or nearby coal companies can recover their bonds and determine effects on aquifer reconstruction in coal mine areas
- Discharge of CBM-produced waters could affect new coal mines if entering the mine permit boundaries
- Effects on oil and gas development from other resource protection measures
- Loss of methane resource because of venting from coal mines
- Drainage of methane from federal minerals from offsetting state and private wells
- Quantity of methane recovered
- Effect of over-pumping CBM water on gas recovery
- Subsurface coal fires
- Potential loss of coal production due to CBM development

Hazardous Materials and Waste Management

- Use of hazardous materials and potential for misuse as a part of CBM development

Hydrology

Groundwater

- Produced water quality and appropriate beneficial reuses
- Drawdown of aquifers and drying up of natural springs due to CBM production
- Appropriate water management alternatives
- Water quality impacts
- Water rights conflicts
- Changes in pumping rate and cumulative drawdown due to CBM development
- Impacts on down- and up-gradient water resources in both confined and unconfined aquifers

- Long-term effects of CBM pumping on aquifer recharge and groundwater resources
- Effects on DNRC established Powder River Basin Controlled Groundwater Area
- Shallow (Class V) and deep (Class II) injection of produced water opportunities

Surface Water

- Effect of high sodium adsorption ratio (SAR) and increased flow rates on eroding stream channels
- Impacts on water quality from produced water
- Impacts on biota from water quality changes
- MPDES discharge analysis for CBM-produced waters
- Cumulative impacts on water quality and quantity
- Impacts on irrigated cropland

Indian Trust Resources and Native American Concerns

- Unique Native American concerns and social impact on Native Americans
- The effects of discharged water on agriculture, fishing, hunting, and gathering of native and sacred plants as they relate to traditional values held by the tribes
- Protection of Indian trust assets with regard to resource drainage and reduction of usable assets
- Water quality preservation agreement with the Northern Cheyenne
- Effects to reservation PSD Class I area classification and nonattainment area
- Impacts on sites with traditional cultural importance to Native Americans in areas on and adjoining the reservations
- Increased use of public facilities and services on reservations
- Cultural and socioeconomic impacts on tribal members associated with CBM development

Lands and Realty

- Construction effects from drilling, roads, pipelines, and water disposal facilities
- Infrastructure needed to accommodate CBM development would require numerous road, powerline, and pipeline ROW

Livestock Grazing

- Impacts on grazing lands from discharge of high salinity water
- Effects on livestock and ranching operations from the increased availability of water
- Displacement of grazing lands from the development of CBM well pads and loss of natural forage
- Change in vegetative communities to more salt-tolerant species that are generally not preferred by livestock

Paleontological Resources

- Impacts from vandalism and unpermitted collectors as a result of increased access to remote areas
- Impacts on paleontological localities from oil and gas development

Recreation

- Effects on hiking, hunting, and other recreational activities from CBM development
- Displacement and disturbance of wildlife and habitat will affect hunting, hiking, and other recreational activities

Social and Economic Values

- Increased levels of background noise and what noise mitigation would be conducted
- Impacts on social service agencies and local economics from increased population
- Decreased land values
- Escalated real estate prices
- Agricultural job loss

- Economic effect on local communities, including potential increased wage income, lower unemployment, increased local business, and potential costs of a “boom and bust” scenario
- Cost to residents from potential CBM production affects on springs, livestock watering, and domestic water
- Social structure impacts through direct impacts on the local economy
- Revenue associated with the amount of methane recovered
- Tax revenue to local, state, and federal entities
- Effects on local economies and lifestyle from royalties to the state and federal government
- Royalties to local landowners who own mineral rights and surface disturbance payments to landowners who do not own mineral rights
- Lack of royalties or tax revenues available for Tribes from non-Indian oil and gas leases.
- Benefits from more abundant clean energy
- Effect from Wyoming CBM development (cumulative)
- Economics of mitigation strategies
- Socioeconomic effect from lowering the water table
- Quantity of economical oil and gas resources and market implications
- Effects to agricultural productivity from SAR levels
- Effects to agriculture from air, soil, and water contamination
- Private surface owner notification prior to work
- Mechanism needed for land owner input on drilling, and leasing and mineral estate issues

Environmental Justice

- Make distributive justice analysis part of the public comment and decision process
- Northern Cheyenne Tribal Government’s reliance on operator lease fees from tribal ranchers and irrigators operating on private and reservation lands

Soils

- High sodium effects: dispersion of soil colloids, reduced water infiltration, vegetative composition and population changes, mud pits and bogs, change in crop production yields, and changes in crops grown because of salinity tolerance levels
- Effects on soils from surface discharge flow changes: erosion on stream banks and in ephemeral drainages if these are the discharge points (increased erosion where dispersion occurs)
- Effects on irrigated soils: changes in salt content in soil profile, changes in salt composition, saline seeps downgradient from irrigated soils, dispersion of soil colloids (reduction of soil permeability and increased erosion), and changes to micro-organism populations and composition
- Development effects: disturbance during drilling at pads (exposure to wind and water erosion), and road development (loss of soil used to develop road beds, and packing soil in undeveloped roads, leading to wind erosion)
- Effects on irrigation and crop management practices: addition of additional water for leaching fraction, potential for water logging soils, modification of irrigation systems, change in cropping equipment, and effects on crops
- Effects from land subsidence and disturbance

Vegetation

- Effect of surface discharge of high sodium or SAR water on native vegetation species that are salt intolerant, as well as on streamside vegetation
- Change in vegetative communities to more salt-tolerant species
- Loss of surface vegetation from construction
- Invasion of exotic and noxious plant species in disturbed areas
- Loss of plant productivity from development
- Protection of grasslands within the Powder River Basin
- Agricultural land withdrawal for CBM production

Special Status Species

- Mitigation measures or avoidance needed to manage and protect candidate and sensitive species

- Loss of threatened and endangered species from development

Visual Resource Management

- Visual degradation from construction of production facilities, roads, powerlines, and pipelines
- Visual pollution

Wilderness Study Areas

- Effects on wilderness study areas from CBM exploration and development

Wildlife

- Impacts from infrastructure development and increased human disturbance on wildlife habitat availability, quality and integrity, escape habitat, and management plans of MFWP
- Fragmentation of wildlife habitat
- Effects from water availability, quality, and quantity
- Loss of animals from hazards to the habitat, such as vehicles, equipment, and increased human access
- Effects on major waterways, such as the Tongue and Powder rivers, and to aquatic ecosystems, including fisheries
- Effect on migration patterns
- Change in vegetative communities to species that are generally not preferred by wildlife
- Effects from increased noise levels
- Effects from powerlines

CHAPTER 2

ALTERNATIVES

MONTANA

CHAPTER 2: ALTERNATIVES

Introduction

The Council on Environmental Quality regulations require that an environmental impact statement (EIS) "rigorously explore and objectively evaluate all reasonable alternatives...." This chapter presents in detail the No Action Alternative (Existing coal bed methane [CBM] Management) and four action alternatives for managing oil and gas resources—specifically CBM exploration and production—throughout the planning area state-wide, with emphasis in the Bureau of Land Management's (BLM's) Powder River and Billings Resource Management Plan (RMP) areas. Other alternatives were considered but eliminated without detailed analysis. A description of these alternatives and reasons for elimination are provided in the Alternatives Considered But Not Analyzed in Detail section.

This chapter is presented in five sections: Alternatives Development, Alternatives Considered But Not Analyzed in Detail, Management Common to All Alternatives, Management Actions Specific to Each Alternative, and Comparison of Impacts.

Alternatives Development

The purpose of developing and presenting alternatives is to allow the decision maker an opportunity to address and resolve issues recognized during the scoping process. Alternatives meet the purpose and need for doing the plan, and balance ways to address different resource issues. The resolution of key issues forms the framework of an alternative, with the resolution of lesser issues included around the alternative's central idea. This section describes how those key issues led to the development of the alternatives. The development of alternatives for this EIS centered on addressing regulatory issues in seven general areas:

- Air quality
- Coal mines
- Coal bed methane
- Hydrology
- Realty
- Indian trust resources
- Environmental mitigation

Although other relevant issues were considered, these key issues played a major role in defining the alternatives to be analyzed in detail.

Air Quality

Alternatives were developed by considering potential changes in ambient air quality from CBM activities, such as reduced visibility, air quality emissions, dust emissions, harmful gases, and changes in climate. Alternatives vary by limiting the number of wells connected to each compressor, the type of fuel required to power compressors (diesel, electric, or gas-fired), and whether noise suppression measures would be required.

Coal Mines

The alternatives address buffer zone requirements around active coal mines, as well as the ability for adjacent or nearby coal companies to recover bonds and determine the effects on aquifer reconstruction. Alternatives also include CBM water discharge affecting new coal mines, the effects on oil and gas development, loss of coal production resources from CBM development, loss of methane resources because of venting, and subsurface coal fires. Alternatives vary by the use of a buffer zone around active coal mines.

Coal Bed Methane

Restrictions on CBM exploration and production activities were considered in developing the alternatives. Alternatives vary by directional-drilling

What has Changed in Chapter 2 Since the Draft EIS?

Chapter 2 lists the alternatives development process and describes the features of each alternative in detail. Based on public comment, a new section was added to Chapter 2 that describes the development of the alternatives. The mitigation measures common to all alternatives previously mentioned in Chapter 4 have been moved to Chapter 2 and are presented in Table 2-1. Some additional mitigation measures, including measures specific to the Native American Tribes were incorporated into Alternative E—Preferred Alternative. Table 2-2, presents the various alternative management approaches and was revised for simpler and more direct presentation. Table 2-3, which compares the impact of the alternatives by resource area, includes the results of the additional mitigation measures. In the DEIS, this table was in Chapter 4. It was moved here for the Final EIS. Text throughout the chapter was revised for simpler presentation.

requirements; the number of coal seams per well bore, and chronological seam development. Whether a Project Plan of Development is required in consultation with tribes, surface owners, and other agencies is also addressed differently under each alternative. Other matters considered are drainage of methane from federal minerals, methane quantities, and the effect of over-pumping water.

Hydrology

Hydrology issues used in developing alternatives include inspection, treatment, storage, and conveyance of CBM-produced water. Short- and long-term effects on groundwater and surface water, impacts on water quality, and water rights were considered. The alternatives differ by requirements for site-specific Water Management Plans, treatment, conveyance methods, and the beneficial use of exploration and production water. Farmers, ranchers, irrigators, coal mines, light industry, transportation departments, local county governments, and others could beneficially reuse production waters.

Realty

Realty matters center on requirements for ROW corridors, powerline placement, and use of or abandonment of roads from CBM development. The alternatives vary by whether roads would be open to public use, closed and returned to a natural vegetative state, or maintained at the discretion of the surface owner. Other differences between the alternatives include requirements for buried powerlines, installation of raptor safety equipment, and multiple utility corridor use.

Indian Trust Resources

The Crow Tribe of Indians, Fort Belknap Indian Community, and the Northern Cheyenne Tribe are located within the emphasis area for CBM development and therefore, were given special consideration with regard to potential impacts from off-reservation operations. Issues considered include the potential drainage of Reservation groundwater and CBM by off-reservation wells, impacts to sacred sites and resources, water rights, water quality preservation agreements, stress to reservation infrastructure, cultural sites, and socioeconomic status. To address these issues, the use of a federal buffer zone as well as monitoring requirements were included in various alternatives.

The Northern Cheyenne Tribe has proposed a series of mitigation measures, in which the BLM has incorporated into a table, a copy of which can be found in the Northern Cheyenne Mitigation Appendix attached to this EIS. The BLM has considered these measures for implementation and have developed corresponding requirements that are included in Alternative E—Preferred Alternative.

Environmental Mitigation

Environmental mitigation measures to address resources were presented in the scoping comments. The mitigation measures have been incorporated into the management actions of the various alternatives. These include commercially harvesting trees within rights-of-way (ROWs); implementation of high fire danger restrictions; road use enforcement; road placement restrictions; wellhead camouflage requirements; conducting wildlife surveys; and the use of early successional species along with appropriate late seral stage native species for revegetation. The environmental mitigation measures are applied to the various alternatives based on their general themes for either protection of existing resources or emphasis on CBM development.

Alternatives Considered But Not Analyzed in Detail

The alternatives below were considered for resolving planning questions or issues, but were not analyzed in detail because of technical, legal, or other constraints.

Leasing

BLM oil and gas leasing decisions and lease stipulations, including those applicable to CBM, were previously analyzed in the BLM 1992 *Final Oil and Gas RMP/EIS Amendment* (BLM 1992). Those decisions were approved in the project's *Record of Decision* (ROD) published in February 1994. During that process, the public was invited and encouraged to participate. The existing lease stipulations approved in the 1994 ROD continue to be applicable to all CBM development and have been included in Table MIN-5 of the Minerals Appendix. CBM is part of the oil and gas estate. Existing oil and gas leases include the right to explore and develop CBM. Issuing separate leases for conventional oil and gas and separate leases for CBM would require a regulatory change.

The purpose of this document is to analyze levels of conventional oil and gas and CBM development that are greater than those analyzed in the BLM 1992 Final Oil and Gas RMP/EIS Amendment. Analyzing new federal lease decisions such as closing federal areas of oil and gas estate in the Powder River and Billings RMP areas, are therefore beyond the scope of this plan. This plan will identify necessary mitigation measures that would be applied during the permitting process. The environmental analysis conducted for federal permits can influence where and what level of CBM development can occur.

Bonding

Establishment of bond amounts specifically for CBM development activities that cover the full cost of CBM development. This alternative is not analyzed in detail because the MBOGC and BLM regulations set minimum amounts of bonding required before approving drilling permits. The regulations allow agencies to raise the bond amount required depending on such factors as the number and type of wells, type and amount of reclamation necessary, and operator history. Bond increases cannot exceed the total of estimated costs of plugging and reclamation, the amount of uncollected royalties due and monies owed because of outstanding violations.

Omega Alternative

The Omega Alternative to drill a large-diameter well through the coals and from the base of that shaft to directionally drill upward into the various coal seams in a circular pattern is an experimental technology not yet proven for CBM. If this technology becomes viable for CBM extraction in the future, further consideration would be given to it.

Alternate Sources of Energy

The purpose of this EIS is to consider management requirements for CBM and conventional oil and gas development. Considering alternate sources of energy such as wind power and fuel cells is therefore beyond the scope of the EIS.

Re-Injection of Produced Water into the Same Aquifer Alternative

Re-injection of produced formation water is an accepted practice in conventional oil fields but its use in CBM fields would be counterproductive if the produced water was re-injected or could migrate into the CBM producing formation. In conventional oil fields, operators have re-injected produced water since the 1920s to help maintain reservoir energy and to increase ultimate production efficiency, or to move oil preferentially to producing wells. When produced water is re-injected, original reservoir pressures are maintained; this can significantly increase the percentage of original oil in place that is produced before the field's economic limit is reached (Thomas et al. 1987). Re-injection can also sweep oil out of the reservoir toward producing wells in a waterflood, also increasing production efficiency. In these scenarios, water production is neither desired nor absolutely necessary; it is a nuisance that can be minimized with standard engineering practice. In the history of many oil fields, oil is produced water-free for months or even years before water is seen in producing wells.

In CBM production, formation water must be produced before reservoir pressures are sufficiently reduced for the adsorbed methane to be liberated. Water production is unavoidable and pre-requisite to CBM production. As water is produced from the coal seam, the pressure in the seam is reduced. Research by the BLM's Casper, Wyoming, Field Office suggests that methane production begins after 20 percent of the virgin reservoir pressure is depleted; significant production does not begin until 40 percent of the pressure is depleted (Crockett and Meyer 2001). Work by Jones et al. (1992) corroborates this relationship. If methane production is directly related to depletion of reservoir pressure, then re-injection of produced water within the confines of the CBM field will directly result in the decrease of methane production. Re-injection of CBM-produced water into the producing formation is not a reasonable option for management of produced water. When and if this technology becomes viable, a more detailed analysis would be conducted for further consideration.

It would be reasonable to inject produced water into non-productive coal seams that were geologically separated from the CBM field. Separation could be the result of faulting or erosion, isolating coals in the injection area even from stratigraphically equivalent productive coal seams in the CBM field. Under Alternative B the injection of produced water into either non-productive coal seams or aquifers with water of lesser quality is analyzed.

This type of injection results in preservation of the produced water resource, whether of high or low quality. The permit process could mitigate impacts to groundwater so that the quality of the injected water is matched to the quality of the formation water in the prospective injection zone.

Phased Development

Staged or phased development was presented to BLM during scoping in several ways. First, the number of rigs operating in the emphasis area could be controlled and leases would be developed in stages. Second, companies would be allowed to develop production in one geographic area at a time and when complete, move to another. Lastly, corridors could be left undeveloped to allow for wildlife movement.

BLM has a legal obligation to ensure that leased federal minerals are reasonably developed and that federal minerals are not drained by production that occurs on non-federal leases. The State of Montana and private parties own much of the minerals and surface in the emphasis area, resulting in a checkerboard pattern that could compromise the BLM's legal obligation to protect federal minerals.

This alternative is not reasonable in the case of oil and gas leases because each lessee has an investment-backed expectation that its applications for permits to drill will be considered in a timely manner and approved absent unacceptable site-specific impacts. See the Supreme Court decision in *Mobil Oil Exploration and Producing Southeast, Inc. v. United States*, 530 U.S. 604, 620 (2000), which found a breach of contract when the Minerals Management Service, pursuant to a later adopted statute, would not review and make a timely decision on development plans per the regulations. In addition, the Mineral Leasing Act and 43 CFR 3100 require maximum ultimate economic recovery of oil and gas from leased lands. In light of the broad geographic distribution of leases in the Powder River Basin, phased development in any fashion would not allow compliance with the above requirements.

Although, BLM must balance these mandates with its responsibility to use multiple use principles to prevent unnecessary or undue degradation in managing the public lands pursuant to FLPMA. This document does not support a finding that these competing responsibilities would be in conflict.

Management Common to All Alternatives

Management common to all alternatives are the management practices for conventional oil and gas, as well as CBM lease operations, that are the same in each alternative, including the Preferred Alternative.

Bureau of Land Management

The BLM has primary responsibility for managing the federally owned oil and gas estate. After lease issuance, operations may be conducted with an approved permit. Proposed drilling and associated activities must be approved before beginning operations. The operator must file an Application for Permit to Drill (APD) or Sundry Notice (SN) that must be approved according to (1) lease stipulations; (2) onshore oil and gas orders; and (3) regulations and laws. The steps required to obtain approval to drill and conduct surface operations are summarized in Appendix A of the 1992 Final Oil and Gas RMP/EIS Amendment and in the Minerals Appendix of the BLM's Big Dry Resource Management Plan/Environmental Impact Statement for the Big Dry Resource Area of the Miles City District (Big Dry RMP/EIS) (1995). The process described therein is common to all alternatives.

In addition, under requirements of the Clean Air Act (CAA) and the Federal Land Policy and Management Act (FLPMA), any activity the BLM authorizes (including oil and gas development) must comply with all applicable local, state, tribal, and federal air quality laws, regulations, standards, increments, and implementation plans. Therefore, land use authorizations will specify that operating conditions (i.e., air pollutant emissions limits, control measures, effective stack heights, etc.) are consistent with the applicable air regulatory agency's requirements.

State of Montana

State agencies that have authority over oil and gas activities include the Department of Natural Resources and Conservation (DNRC), which includes the Montana Board of Oil and Gas Conservation (MBOGC), the Trust Land Management Division (TLMD) and the Water Resources Division; and the Montana Department of Environmental Quality (MDEQ). Each of these agency's roles and responsibilities were discussed in Chapter 1. Current oil and gas development is managed under the guidelines developed in the MBOGC's Oil and Gas Drilling and Production in Montana: Final Programmatic Environmental Impact Statement (1989). This document outlines how to incorporate any necessary environmental review into its rules and permitting process in an effort to comply with the Montana Environmental Policy Act (MEPA). In conducting environmental reviews for new permits, MBOGC works with other state agencies that may become involved in the process.

Mitigation Measures

Management practices common to all alternatives include numerous mitigation measures categorized by resource topic. These mitigation measures are derived from current leasing stipulations, standard operating procedures, and MBOGC field orders. A list of the mitigation measures considered common to all alternatives is provided in Table 2-1.

Not all mitigation measures are applicable under all leases; do to the variances between Federal, State and private surface and mineral ownership. MEPA compliance by state agencies may result in site-specific mitigation measures being developed that are not listed in Table 2-1. Specific mitigation measures to be applied depend upon the ownership of both surface and minerals and upon the land management agency and regulatory agency involved. The TLMD is the land manager for state owned lands; BLM is both land manager and regulatory agency on BLM land; and private land owners are managers of the private land. The Board of Oil and Gas is the regulatory agency for state and private lands. Note, current leasing stipulations are not being amended under this EIS, but can be found in tabular form in the Minerals Appendix, Table MIN-5.

Management Actions Specific to Each Alternative

Five alternatives have been developed to evaluate the impacts related to the various development scenarios associated with CBM exploration and production. Each alternative represents a different approach for resolving the issues identified during scoping. Alternative A, the No Action Alternative, would continue existing management. Alternative B would allow CBM development while emphasizing resource protection. Alternative C would emphasize CBM development with minimal environmental restrictions. Alternative D would encourage CBM exploration and development while maintaining existing land uses. Alternative E is the Preferred Alternative and would allow for CBM exploration and development while sustaining resource and social values, and existing land uses.

Each alternative was structured to stress different development emphasis, such as resource protection, CBM development, and existing land uses.

Alternative A—No Action (Existing Management)

This section describes the current management practices used by the BLM and the state to manage the exploration, development, and operation of CBM wells in Montana.

BLM

The BLM issues oil and gas leases that include the right to explore for and develop CBM. The Final Oil and Gas RMP/EIS Amendment allowed for the drilling of test wells and initial small-scale development of CBM. Under existing management, APDs for CBM wells would be approved on a case-by-case basis, only in specific geographic areas where little or no CBM data is available. The APDs would only authorize the drilling and testing of wells and associated construction activities. CBM production would not be authorized nor would the operator be allowed to discharge waters into State or U.S. streams or drainages. All current leasing stipulations regulating mitigation measures would be applied to new leases and enforced on current leases. APDs for CBM exploration and testing would be considered for possible approval, on a case by case basis, under an evaluation criterion that would include, but not be limited to, areas where the following apply:

- The proposal is in conformance with the Powder River and Billings RMPs
- Data for coal, gas or groundwater does not exist
- Data for coal, gas or groundwater is limited
- Data for coal, gas or groundwater might be dated or unreliable
- Data for coal, gas or groundwater is only available from certain coal seams
- The proposed placement of wells would optimize data collection
- The well, if not productive, could be useful for monitoring

APDs for coal bed methane wells would not be considered for approval in areas where the following apply:

- The proposal is not in conformance with the Powder River or Billings RMPs

TABLE 2-1
MITIGATION MEASURES COMMON TO ALL ALTERNATIVES

Resource Topic	Mitigation Measure	Applicability by Surface Ownership		
		BLM	State	Private
Air Quality	Access roads, well pads and production facility sites constructed on soils susceptible to wind erosion will be appropriately surfaced to reduce fugitive dust emissions	X	X	
	Dust inhibitors will be used as necessary on unpaved collector, local, and resource roads to reduce fugitive dust emissions to the air and resources adjacent to the road	X	X	
Cultural Resources	Cultural resource reviews/surveys will be conducted as required by BLM or TLMD prior to the commencement of construction or other surface disturbing activities authorized by BLM or TLMD. Results of the survey will be presented as part of the permit review or approval process. Decisions regarding relocation of proposed access roads or well pads, data recovery, and excavation will be made to protect the cultural or historical sites	X	X	
	Surface occupancy and use is prohibited within sites or areas designated for conservation use, public use, or sociocultural use	X		
Geology and Minerals	No Surface Occupancy stipulations are placed on new oil and gas leases which are issued for lands that have existing coal leases	X		
	Reclamation is required on areas of surface disturbance during the production and abandonment phases of development	X	X	
Hydrological Resources	Water well and spring mitigation agreements will be used to facilitate the replacement of groundwater lost to drawdown. Replacement water may require supply from offsite sources	X	X	X
	The Montana and Wyoming Water Quality Agreement pending final approval will preserve the current water quality in the Tongue River and prevent Wyoming operators from discharging poor-quality production water into the Tongue River	X	X	X
Lands and Realty	Surface disturbance on federal lands will be reclaimed following the BLM seeding policy (BLM 1999c)	X		
	Roads and utility ROW impacts experienced prior to reclamation are mitigated by requirements for repair or replacement in the site-specific review, or through compensation for actual damages	X	X	X
	Property damage would be repaired or replaced according to landowner agreements at the operator expense	X	X	X
Livestock Grazing	Repair or replace damaged gates and fences according to landowner requirements at operator's expense	X	X	X
	When working on or near grazing lands, project-related construction equipment and vehicle movement will be minimized to avoid disturbance of grazing lands	X	X	

TABLE 2-1
MITIGATION MEASURES COMMON TO ALL ALTERNATIVES

Resource Topic	Mitigation Measure	Applicability by Surface Ownership		
		BLM	State	Private
Livestock Grazing, 'cont.	Responsibilities for fence, gate, and cattle guard maintenance; and noxious weed control will be defined in APDs, Agency Approvals, or ROW grants	X	X	
	Facilities will be placed to avoid or minimize impacts on livestock water	X	X	X
Paleontological Resources	The BLM APD contains guidance for notifying and mitigating damage to paleontological resources discovered during oil and gas construction activities. Limitations include restricted use of explosives for geophysical exploration, monitoring requirements, and work stoppages for discovered damaged resources	X		
	Surface occupancy and use is prohibited within designated paleontological sites	X		
	The Bridger Fossil Area is a designated Area of Critical Environmental Concern (ACEC) is not available for oil and gas development	X		
Recreation	Surface occupancy and use is prohibited within established recreation areas and undeveloped recreation areas receiving concentrated use on lands administered by BLM	X		
	Exploration activities would be coordinated for timing to minimize conflicts during peak use periods	X		
Social and Economic Values	Economic impacts on groundwater users would be mitigated by the mandatory offering of water well and spring mitigation agreements	X	X	X
Soils	Areas with steep topography will be developed in accordance with the BLM Gold Book (USDI and USDA 1989) requirements	X		
	Federal leases with slopes in excess of 30 percent will be required to obtain approval for occupancy from the BLM based on mitigation of erosion, surface productivity after remediation, and mitigation to surface water quality	X		
	Riparian zones will be protected by federal lease stipulations and permit mitigation measures	X		
	Lease roads and constructed facilities will be limited based on the Surface Use Program in the APD	X		
	In areas of construction, topsoil will be stockpiled separately from other material, and be reused in reclamation of the disturbed areas	X	X	X
	The BLM Seeding Policy will be followed for all reclamation and reseeding activities	X		

TABLE 2-1
MITIGATION MEASURES COMMON TO ALL ALTERNATIVES

Resource Topic	Mitigation Measure	Applicability by Surface Ownership		
		BLM	State	Private
Soils, 'cont.	Surface owners or surface lessee will be consulted regarding the location of new roads and facilities related to oil and gas lease operations	X	X	X
	Unused portions of the drill location will have topsoil spread over it and reseeded	X	X	
	Construction activities will be restricted during wet or muddy conditions	X	X	
	Construction activities will be designed following Best Management Practices (BMPs) to control erosion and sedimentation	X		
	If porous subsurface materials are encountered during drilling, all onsite fluid pits will be lined	X		
	During road and utility ROW construction, surface soils will be stockpiled adjacent to the sides of the cuts and fills	X		
	Stream crossings will be designed to minimize impacts and impede stream flow	X	X	
	Erosion control measures will be maintained and continued until adequate vegetation (defined by BLM or TLMD on a case by case basis) cover is re-established	X	X	
	Vegetation will be removed only when necessary	X		
	Water bars will be constructed on slopes of 3:1 or steeper	X		
	Solid and Hazardous wastes generated as a result of oil and gas lease operations will be disposed of in a manner and at a site approved by the appropriate regulating agency.	X	X	X
Solid and Hazardous Wastes	Site clearance surveys would be conducted prior to surface disturbance commencement	X	X	
Vegetation	Additional lease stipulations applicable to either the state or BLM are listed in Table MIN-5 of the Minerals Appendix	X	X	
	Surface occupancy and use is prohibited within designated Visual Resource management Class I areas	X		
Visual Resource Management	All surface-disturbing activities and semi-permanent and permanent facilities in Visual Resource Management Class II areas require special design, including location, painting, and camouflage, to blend with natural surroundings and meet the visual quality objectives of the classification	X		

TABLE 2-1
MITIGATION MEASURES COMMON TO ALL ALTERNATIVES

Resource Topic	Mitigation Measure	Applicability by Surface Ownership		
		BLM	**State**	**Private**
Visual Resource Management, 'cont.	Laws and regulations established to protect Wilderness Study Areas (WSA) prohibit leasing of designated WSA lands for resource extraction	X		
	Existing oil and gas leases in WSAs will be developed in accordance with the BLM policy for interim management of WSAs			
Wilderness Study Areas	An extensive list of no surface occupancy and no surface use stipulations by species is presented in the Wildlife section of Chapter 4. These stipulations limit and exclude use within designated distances from known species' specific nesting areas and habitat	X		
Wildlife	Other restrictions governing development timing, controlled surface use, and avoidance measures are listed in Table MIN-5 of the Minerals Appendix	X	X	
	Surface occupancy and use is prohibited within 1/4 mile of designated reservoirs with fisheries	X		
Aquatic Resources	Surface occupancy and use is prohibited within 1/4 mile of designated reservoirs with fisheries	X		

- Sufficient and accurate data exists for coal, gas, and groundwater
- Other coal bed methane wells are being drilled, including the 200 CBM wells the MBOGC can approve for exploration
- Other coal bed methane wells are producing
- Monitoring wells are in place or not needed

Water produced during the testing phase would not have to be treated and would be contained at the well site in either a pit or a steel tank. The water would be available for beneficial use by industry (for example, pipelines, dust abatement) and landowners. Wells drilled on federal minerals would be shut-in or plugged after completion of the testing phase.

Coal seams targeted for exploration would be determined by industry and not by the government. Vertical wells producing from a single coal seam would be allowed. Vertical wells producing from multiple coal seams would not be required. Operators would be required, when technologically and economically feasible, to drill several wells from a single well pad, which may require directional drilling. The placement of wells would not be restricted through the use of buffer zones around active coal mines or Indian reservations.

Transportation corridors for vehicles would not be required; however, operators would be encouraged to use existing routes, corridors, or previously disturbed areas when feasible or as required by the surface owner. Powerlines would be either aboveground or buried according to operator plans. Placement of roads and powerlines or other utilities requiring ROW are subject to environmental review and agency approval. Diesel, electric, or gas-fired engines would power generators used during the testing phase of CBM wells. The number of wells connected to each compressor would be dependent on the operator's development circumstances. Equipment would have to be removed at the end of the testing phase or at the time of abandonment. Areas of surface disturbance associated with lease operations would have to be reclaimed at the completion of activities in accordance with surface owner requirements. Upon abandonment, roads providing legal access to BLM-administered surface would be open to the public.

State

The MBOGC would manage CBM plan of developments based on the Stipulation and Settlement Agreement reached in the First Judicial District Court, Lewis and Clark County, between the MBOGC and the Northern Plains Resource Council, Inc., on June 19, 2000. In this agreement, the MBOGC may, upon proper application by the operator, issue 200 CBM permits for water quality, quantity, and for testing the coals. An additional restriction limits the number of wells per pod to nine and pods per township to one, and prohibits the discharge of any water into the waters of Montana or the U.S. In addition to these exploration wells, the agreement specifies that Fidelity Exploration and Production (formerly Redstone Gas Partners) could apply to the MBOGC for up to 90 additional wells for its CX Field Pilot Project in southeastern Big Horn County. The total producing wells in the CX Pilot Field cannot exceed 250. In addition to these, Fidelity can drill another 75 exploration wells for a total of 325 wells. Discharge of production water has been be arranged through the MDEQ, via a Montana Pollutant Discharge Elimination System (MPDES) permit. The current Fidelity MPDES permit allows for up to 1,600 gallons per minute (gpm) to be discharge into the Upper Tongue River from up to 11 discharge points.

Testing of CBM wells that have been previously drilled would continue, provided no water is discharged to the waters of Montana or the U.S. No commercial production of methane would occur from any of the wells. For each landowner where test wells are drilled, the operator conducting the drilling would enter into a water well mitigation agreement. All wells drilled under the terms of the settlement agreement would be required to comply with the MBOGC's regulations. After test wells are completed, they would be abandoned or plugged according to the MBOGC's regulations.

The development of CBM wells also would be subject to the same regulatory requirements outlined in the Management Common to All Alternatives section for conventional oil and gas. These include following current lease stipulations and mitigation measures. The stipulation and settlement agreement remains in effect until a Record of Decision (ROD) is formulated and signed for this EIS.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

This alternative would allow CBM development while emphasizing the protection of natural and cultural resources.

The following measures would be required to reduce environmental impacts.

All generators and compressors would have to be powered by natural gas-fired engines. The number of wells connected to each compressor would be maximized to reduce the overall number of field compressors.

To the extent agency authority allows, buffer zones would be established around Indian lands and active coal mines. Until a reservation approves production of CBM on their lands, a 2-mile buffer would be enforced around reservations in Montana. A 1-mile buffer would be enforced around active coal mines where no CBM production would be permitted.

Water from exploration wells would be stored in tanks, or other approved non-discharging storage facilities. Water from producing wells would be injected into a different aquifer with the same or lesser quality water. Class V permits for injection of produced water with less than 3,000 milligrams per liter (mg/l) total dissolved solids (TDS) would need to be obtained from the EPA Region VIII. If the produced water has dissolved solids in excess of 10,000 mg/l, it would need to be disposed of via the Class II UIC program maintained by the MBOGC. Produced water between 3,000 and 10,000 parts per million (ppm) TDS can be disposed of in a Class II well permitted by MBOGC with concurrence from EPA. Regardless of the water quality or class of well, the produced water would not be injected into the same coal seam that the methane was being extracted from unless there was some form of geological separation to prevent migration of the injected water into the area of methane production.

There are several potential limitations to injecting all the water in this alternative. Since certain geological conditions are desirable for injection and they are not always present in the near surface, it is conceivable that in some cases deep injection into the Madison limestone would be required. Formations that are potential zones for injection may also have limited capacity to accept large volumes of water. Due to the high cost of injection and the uncertain success in disposing of all produced water over the life of a group of CBM wells, injection has not yet been shown to be commercially viable for the CBM industry in the PRB.

Co-location by spacing unit, of single-seam development wells on the same well pad would be required. Multiple seam completions in a single well bore would be encouraged to the extent technology permits. CBM production could occur simultaneously from multiple seams or staggered over time from separate seams. Directional drilling would be required for deeper coal seams to avoid excess surface use or disturbance.

Roads to wells and compressor sites would be limited to single lane width with turnouts. Exploration wells would not have permanent gravel access roads. Utilities would be placed along the road routes, using the transportation network as utility corridors. Powerlines would be buried in the utility corridors; no overhead lines would be permitted. Produced water flowlines and gas flowlines would be buried in the same trench when feasible. When the well had reached the end of its useful life, new access roads on BLM and state surface would be rehabilitated if closed.

The following paragraphs address environmental mitigation measures envisioned to reduce impacts on various resource topics.

During the construction of ROWs and roads, commercially valuable trees would be harvested and the proceeds paid to the resource owner. Long-term loss of commercial timber production on these lands would be negotiated with the TLMD and private landowners.

Use of CBM-related roads would be limited to industry and enforcement would be increased through the use of additional fences and gates to reduce public access and overuse. This effort would help educate residents that these roads are not part of the public road network. Speed limits would be posted and enforced to reduce fugitive dust emissions. Road placement would be limited to tract boundaries where practical to reduce impacts on residential and agricultural lands.

Operators will be required to comply with agency imposed conditions during times of high fire danger. Such conditions may include restrictions on types of activities allowed, hours of operation, and requirements for maintaining certain fire suppression equipment at the work site. Operators must maintain a current fire suppression.

To reduce noxious weeds from spreading during CBM-related activities, operator's weed prevention plans must include measures to prevent the spread of weed seeds from any vehicle or equipment. Additionally, during reclamation activities, early succession plants would be used for revegetation to provide a quick cover before noxious weeds can take root.

Wildlife surveys required by BLM to identify special status species would be conducted prior to the approval of APDs. Qualified wildlife biologists would conduct the surveys and results would be reported to MFWP for consultation regarding avoidance and/or other wildlife protective measures.

Alternative C—Emphasize CBM Development

This alternative would emphasize CBM exploration and development with minimal restrictions.

Operators could use diesel engines with Best Available Control Technology (BACT) to reduce emissions. Operators would not be required to connect a minimum number of CBM wells to a field compressor nor limit the number of field compressors delivering gas to a sales compressor.

Roads and utility corridors would be positioned to use existing disturbances as much as possible. Powerlines would be aboveground or buried per the operator's plans. Gas and water lines would be buried. Upon abandonment, new BLM and state surface oil and gas roads would be rehabilitated and closed.

Operators would not be required to drill directional or horizontal CBM wells. Wells would be located by the operator, and agencies would not require multiple wells to be located on the same well pad.

Water management would be based on a combination of beneficial use and surface discharge. Beneficial uses would include stock water, coal mine dust suppression, irrigation, constructed wetlands, domestic water supply, produced water as drilling fluid, de-icing of road aggregate storage piles, industrial needs, and agricultural reuse. Surface discharge would be subject to MDEQ permit requirements MPDES and limitations established for discharge into identified watersheds. Water discharge via a transportation pipeline into a drainage system would not be required. The operator must obtain 401 Certification from the MDEQ if the disposal action needs BLM approval. Injection of produced CBM water would not be required.

A CBM production buffer zone would not be imposed around Indian reservations or coal mines.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

This alternative would encourage CBM development while maintaining existing land uses and protecting downstream water consumers. The following paragraphs address environmental mitigation measures envisioned to balance development with resource protection.

The number of wells connected to each compressor would be maximized to reduce the overall number of field compressors required. Natural gas engines with electric boosters would be required for all compression operations. Operators would be required, when technologically and economically feasible, to drill several wells from a single well pad, which may require directional drilling. Multiple seam completions in a single well bore would be encouraged. The transportation network also would serve as a utility corridor. Roads and utilities would be constructed with one way in and out. All powerlines and water and gas flowlines would be buried. Upon abandonment, new oil and gas roads on BLM and state surface would be rehabilitated if closed. Roads would remain open or closed at the surface owner's discretion.

To the extent agency permitting allows, buffer zones for production would be established around Indian lands (2 miles) and active coal mines (1 mile). The buffer zone around Indian lands would remain in effect until the tribe approves production on its own lands.

All produced water (depending on water quality) would be treated prior to surface discharge or pumping into holding facilities such as impoundments, pits, and ponds. Transportation of treated water for discharge would be via a constructed drainage system or pipeline to the nearest perennial watercourse if possible. The method of treatment is unrestricted, provided the effluent meets standards established by the MDEQ for downstream use. Beneficial use of produced water would be allowed and treatment would vary based on industrial, municipal, or agricultural uses such as power plant cooling water, coal slurry pipeline, field irrigation, livestock or wildlife watering, or municipal power turbines. The operator must obtain 401 Certification from the MDEQ if the disposal action needs BLM approval. Surface storage of produced waters would also require an MPDES permit issued by MDEQ.

Use of CBM-related roads would be limited to industry and enforcement would be increased through the use of additional fences and gates to reduce public access and overuse. This effort would help educate residents that these roads are not part of the public road network. Speed limits would be posted and enforced to reduce fugitive dust emissions on BLM administered surface.

Operators will be required to comply with agency imposed conditions during times of high fire danger. Such conditions may include restrictions on types of activities allowed, hours of operation, and requirements for maintaining certain fire suppression equipment at the work site. Operators must maintain a current fire suppression plan.

To reduce noxious weeds from spreading during CBM-related activities, operator's weed prevention plans must include measures to prevent the spread of weed seeds from any vehicle or equipment. Additionally, during reclamation activities, early succession plants would be used for revegetation to provide a quick cover before noxious weeds can take root.

Wildlife surveys to identify special status species would be conducted prior to the approval of APDs. Qualified wildlife biologists would conduct the surveys and results would be reported to MFWP for consultation regarding avoidance and/or other wildlife protective measures.

Camouflage of all wellheads in Class II Visual Resource Management Areas would be required to preserve the view shed. Camouflage would consist of paint chosen to blend in with the background and placement of wellheads to reduce visual obstructions.

Alternative E—Preferred Alternative

Alternative E is the BLM's proposed RMP amendment and would provide management options to facilitate CBM exploration and development, while sustaining resource and social values, and existing land uses.

Exploration and development of CBM resources on BLM, state, and/or fee minerals are allowed subject to agency decisions, lease stipulations, permit requirements, and surface owner agreements. Operators would be required to submit a Project Plan of Development outlining the proposed development of an area when requesting CBM well densities greater than 1 well per 640 acres. The Project Plan of Development would be developed in consultation with the affected Tribes, affected surface owner(s), and other involved permitting agencies.

A step-by-step guideline for preparation of the Project Plan of Development would be developed by BLM and the MBOGC. The Project Plan of Development would be submitted in draft form so that it can be reviewed and any changes made prior to allowing surface disturbing activities. At a minimum, the Project Plan of Development would have to contain the following:

- A cover letter naming the project area and requesting approval
- An APD (form 3160-3) for each federal well in the project area
- An application for permit form for all state and private wells
- A list of all other permitting agencies involved in the project and the name for a point-of-contact for each office
- A list of all existing wells in the project area, including monitoring wells
- Maps submitted in paper or digital format (CD map with any digital GIS coverages used to create the map), showing proposed roads, compressor stations, pipelines, powerlines, CBM well locations, all existing wells, current and proposed monitoring wells, surface ownership, mineral ownership, surface features, and existing structures
- Master drilling information as required by Onshore Order No. 1 (for BLM lands)
- Master surface use information as required by Onshore Order No. 1 (for BLM lands)
- A Reclamation Plan for surface disturbance
- A wildlife monitoring plan demonstrating how the project will meet the needs of the BLM Wildlife Monitoring and Protection Plan (WMPP) for BLM lands (See Wildlife Appendix for a complete copy of the WMPP)
- A Water Management Plan for the project area
- Surface owner agreements, including water well agreements (or notice that the Surface Owner Damage and Disruption Compensation Act applies and surface owner agreements are pending settlement or court action)
- A list of all potentially affected surface owners within the project area
- A cultural resource plan addressing identification strategies commensurate with the level of the proposed development (for BLM lands). This may include a cultural resource location and significance model for identifying areas of critical concern.
- Any additional information as required by the rules of the MBOGC
- BLM will also require compliance with Onshore Oil and Gas Order Number 7

The Preferred Alternative combines water management options so that there would be no unnecessary or undue degradation as defined by the MDEQ of water quality allowed in any watershed. The preferred water management option of water produced with CBM is for beneficial use. Other produced water management options include, but are not limited to, injection, treatment, impoundment, and discharge. The operator must obtain 401 Certification from the MDEQ if the disposal action needs BLM approval. A Water Management Plan for Exploration would be required for exploratory wells and for each Project Plan of Development. The Water Management Plan for Exploration would be required for CBM exploration wells drilled under statewide spacing rules. At a minimum, the Water Management Plan would be part of an Application for Permit to Drill and include a water well or spring mitigation agreement with the owner of any water well/spring within 1/2 mile; identify any proposed uses of the water (beneficial if possible); and a map showing all wells within 1 mile of the proposed exploratory CBM well.

Water Management Plans developed as part of a Project Plan of Development could include the following additional requirements:

- A cover letter identifying the Project Plan of Development for which the Water Management Plan has been developed and the watershed(s) affected by the project
- A 7.5 minute topographical map indicating the location(s) of any proposed storage ponds and/or discharge points
- Water quality data for the produced water
- Anticipated rate of water production per well and the calculated amount of annual water production for the field
- Proposed beneficial uses of the produced water addressed in surface owner agreements
- Operator's approach to ensure no undue degradation of the surface water quality within the designated watershed(s)
- A copy of any MPDES discharge permit(s) issued by the MDEQ, if required; or a copy of the letter of compliance for MDEQ's General Discharge Permit; or UIC permit issued by the MBOGC or disposal permit issued by the EPA
- A water monitoring plan for the area that meets the requirements of MBOGC Rules and the Controlled Groundwater Area as outlined in the Monitoring Appendix
- A statement indicating whether a 401 Certification if required, and if so, a copy of the certificate
- A copy of the most current soil map available for the project area
- Site-specific stratigraphy for any infiltration basin(s) location that is proposed

Produced water management plans and permits would be approved by the appropriate agency in consultation with affected surface owners. Surface storage of produced waters would also require an MPDES permit issued by MDEQ. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts on soil, water, vegetation, and channel stability. There would be no discharge of produced water (treated or untreated) into the watershed unless the operator has an approved MPDES permit and can demonstrate in the Water Management Plan how discharge could occur in accordance with water quality laws without damaging the watershed.

Shallow coal seams would have vertical wells installed while directional wells may be drilled to the deeper coal seams. Directionally drilled wells would be drilled from the same well pad as the vertical wells, unless the operator can demonstrate why directional drilling is not needed or feasible.

Development of coal seams would be done either one coal seam at a time or multiple coal seams at the same time. Production of CBM would be from one coal seam per well or multiple coal seams per well. During production of CBM from multiple coal seams from multiple wells, the wells would be collected on the same well pad. Well spacing rules would set a limit of one well per coal seam per designated spacing unit.

With regards to air quality, the objectives of this alternative are the same as for Alternative B (the number of wells connected to each compressor would be maximized and natural gas-fired engines for compressors and generators would be required), except in areas with sensitive resources, including people, where noise is an issue. In those areas, the decibel level would be required to be no greater than 50 decibels measured at a distance of 1/4 mile from the compressor. This may require the installation of an electrical booster at these locations. Operators of federal leases would be required to post and enforce speed limits to reduce fugitive dust emissions.

Transportation corridors would not be required; however, proposed roads, flowline routes, and utility line routes would be located to follow existing routes or areas of previous surface disturbance when possible. The operator would also address in the Project Plan of Development how the surface owner was consulted for input into the location of roads, pipelines, and utility line routes.

Powerlines are also a Project Plan of Development consideration. The operator would demonstrate in the Project Plan of Development how the proposal for power distribution would mitigate or minimize impacts on affected wildlife. For example, on BLM lands the operator may be required to bury a portion of the powerlines near sage grouse habitat to safely eliminate use by raptors and any aboveground lines be designed following raptor-safe specifications.

When wells are abandoned, the associated oil and gas roads would remain open or be closed at the surface owner's discretion. If the roads were requested to be closed they would be rehabilitated. This includes leaving BLM and state surface roads open if access is desirable.

There would be no buffer zone for CBM production around active coal mines (IM-2000-053).

The BLM would require federal lease operators to protect Crow and Northern Cheyenne groundwater and CBM from loss or degradation.

Mitigation measures that would be applied to protect Northern Cheyenne Tribal resources are described in the Northern Cheyenne Mitigation Appendix.

In addition to the requirements outlined in the Project Plan of Development and in the Water Management Plan, the following general environmental mitigation measures would be implemented to further reduce potential impacts:

- The air permitting process would include analyses of equipment emissions and associated ambient impacts. Emission sources that may violate ambient standards will not be issued a permit.
- Road placement would be limited to track boundaries where practical to reduce impacts on residential and agricultural lands.
- Displaced farmland, whether in crop production or not, will be reclaimed to original soil productivity through adoption of standard reclamation procedures.
- Operators will be required to comply with agency imposed conditions during times of high fire danger. Such conditions may include restrictions on types of activities allowed, hours of operation, and requirements for maintaining certain fire suppression equipment at the work site. Operators must maintain a current fire suppression plan.
- During reclamation activities, early succession plants will be used for revegetation to provide a quick cover before noxious weeds can take root. Operators would be required to include plans to prevent the spread of noxious weeds as part of their development plans. The noxious weed prevention plans must include measures to prevent the spread of weed seeds from any vehicles and equipment from or prior to mobilizing it to the project area.
- Operator reclamation plans would be developed in consultation with the surface owner. Reclaimed areas reseeded with native species would be required to be reseeded with a certified weed-free seed mix determined by the surface owner, and would usually require at least two growing seasons to ensure a self-sustaining stand of seeded species.
- Camouflage of all wellheads in federal surface Class II Visual Resource Management Areas will be required to preserve the viewshed. Camouflage will consist of paint chosen to blend in with the background and placement of wellheads to reduce visual intrusions.
- Wildlife surveys on state lands to identify special status species will be conducted on potential habitat near drilling and production sites prior to the approval of federal APDs. Qualified wildlife biologists would conduct surveys and results will be reported to MFWP for consultation regarding avoidance and/or other wildlife protective measures.
- On BLM lands impacts to wildlife will be monitored and addressed in the Wildlife Monitoring and Protection Plan (WMPP) in addition to the mitigating measures for wildlife that are part of the standard APD review and approval process. Impacts to wildlife, including those species on public lands and on and adjacent to the Reservations, would be monitored and addressed in accordance with the *Wildlife Monitoring and Protection Plan* (see wildlife appendix).

  The affected Tribes would be invited to participate in the "steering group" that would evaluate information gathered during the inventory and monitoring phases of the Wildlife Monitoring and Protection Plan.
- The results of the *Wildlife Monitoring and Protection Plan* may be used to adjust conditions of approval on federal APDs. This includes measures needed to protect public lands Reservation wildlife from the impacts of CBM development.

The following special survey activities would be conducted for the Gray Wolf, Canada Lynx and Grizzly Bear on BLM lands as needed:

- Gray Wolf—Prior to APD approval, surveys would be conducted specifically for this animal, occupied dens, or scat. The corridor would be surveyed in the spring, before construction, by a wildlife biologist for scat. If scat is found, the site would be surrounded by a buffer zone recommended through consultation with a FWS biologist. If wolves or other wolf indicators are found, FWS would be consulted and proper protocols followed.
- Canada Lynx—Any construction areas or drilling pads located in high elevation, old growth forested areas, especially areas with populations of hares or rabbits, would be surveyed prior to APD approval for scat and individual lynx following established protocols. If found, the site would be avoided and surrounded by a buffer zone recommended by FWS biologists.
- Grizzly Bear—Garbage and other human refuse would be removed from drilling and construction sites on a daily basis in potential bear habitat to avoid attracting bears. Surveys for scat and other sign of grizzly bears in remote areas would be conducted prior to APD approval. If found, protocol would be established after consultation with FWS biologists.

In addition, the following measures as prescribed in the FWS Biological Opinion will be implemented on BLM lands:

- Bald Eagles
    - If a dead or injured bald eagle is located during construction or operation, the FWS Montana Field Office (406- 449-5225), or the Billings Suboffice (406-247-7367) and the Service's Law Enforcement Office (406-247-7355) will be notified within 24 hours of the next working day.
    - Implementation of the Coal Bed Methane Programmatic Wildlife Monitoring and Protection Plan for the Statewide Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans (Wildlife Monitoring and Protection Plan, Wildlife Appendix).
    - Power lines would be built to standards identified by the Avian Power Line Interaction Committee (1996), and additional standards as outlined in the Wildlife Monitoring and Protection Plan, to minimize electrocution potential.
    - Surveys for active raptor nests and winter roost sites would be conducted prior to APD approval within a 0.5-mile width for bald eagles and bald eagle nests and within a 1-mile width for roosts. If the proposed CBM site is found to be within a nesting or winter foraging area, CBM work will be halted until the nest is no longer active or until winter has passed and the foraging eagles have migrated.
    - BLM leasing stipulations pertaining to bald eagles apply and will be implemented. This includes No Surface Occupancy (NSO) within 0.5 mile of nests active in the last 7 years and 0.5 mile of roost sites.
    - Raptor inventories will be conducted over the entire CBM project area every 5 years by BLM and MFWP. These inventories will be repeated every 5 years (in areas with less than four well locations per section) thereafter for the Life-of-the-Project (LOP) to monitor trends in habitat use.
    - Nest productivity would be conducted by the BLM or a BLM approved biologist in areas with high levels of development (i.e., areas with greater than or equal to four well locations per section) and within 1 mile of the project area. Active nests located within 1 mile of project-related disturbance areas will be monitored between March 1 and mid-July to determine nesting success (i.e., number of nestlings or fledglings per nest).
    - A seasonal minimum disturbance-free buffer zone of 0.5 mile would be established for all bald eagle nest sites (February 15 to August 15). These spatial and timing restrictions may be adjusted based on site-specific criteria after written approval from the FWS.
    - Signing, speed limits, or speed bumps would be placed on all project access roads to reduce mortality caused by vehicle traffic.
- Mountain Plover
    - The FWS shall provide operators and the BLM with educational material illustrating and describing the mountain plover, its habitat needs, life history, threats, and gas development activities that may lead to

incidental take of eggs, chicks, or adults. These materials will be provided with the requirement that they will be posted in common areas, circulated in a memorandum, and discussed among all employees and service providers.

- If a dead or injured mountain plover is located during construction or operation, the FWS Montana Field Office (406- 449-5225), or the Billings Suboffice (406-247-7367) and the Service's Law Enforcement Office (406-247-7355) will be notified within 24 hours of the next working day.
- The BLM, FWS, and MFWP will estimate potential mountain plover habitat across the CBM area using a predictive habitat model. During the next 5 years, information will be refined by field validation using most current Service mountain plover survey guidelines (FWS 2002c) to determine the presence or absence of potentially suitable mountain plover habitat. In areas of suitable mountain plover habitat, surveys will be conducted by the BLM or a BLM-approved Operator biologist using the FWS protocol at a specific project area, plus a 0.5 mile buffer. Efforts will be made to identify mountain plover nesting areas that are not subject to CBM development to be used as reference sites. Comparisons will be made of the trends in mountain plover nesting occupancy between these reference areas and areas experiencing CBM development.
- Surveys for nesting mountain plovers will be conducted by appropriately trained personnel if ground-disturbing activities are anticipated to occur between April 10 and July 10. A disturbance-free buffer zone of 1/4 mile will be established around all mountain plover nesting locations between April 1 and July 31.
- No ground-disturbing activities shall occur in suitable nesting habitat prior to surveys conducted in compliance with the Service's Mountain Plover Survey Guidelines (FWS 2002c or more recent version), regardless of the timing of the disturbance. If occupied mountain plover nesting habitat is located, the BLM shall reinitiate consultation with the Service on any project-related activities for such habitat. The amount and nature of ground-disturbing activity shall be limited within identified nesting areas in a manner to avoid the abandonment of these areas.

Because of the potential for CBM development to uncover Tribal culturally significant sites, the BLM would provide the tribes a copy of their annual cultural resources report, which would summarize CBM-related cultural resource activities.

Comparison of Alternatives

The differences between alternatives by development theme are shown in Table 2-2. The variations for development by theme are compared for the five alternatives carried forward for detailed analysis.

A range of potential issues affecting development has been analyzed in the context of the themes described for each alternative. The comparison focuses on the various techniques typically used to develop CBM fields. The variations between alternatives reflect the different potential drilling technologies, water disposal methods, transportation corridor construction, compressor engines, socioeconomic issues, etc. These alternatives represent the majority of development techniques commonly used with CBM operations. There are general and specific assumptions as to percentages of use per theme within each alternative. These assumptions are presented in Chapter 4, Environmental Consequences.

Table 2-3 shows a comparison summary of the impacts expected under each alternative.

TABLE 2-2
ALTERNATIVE MANAGEMENT FOR CBM

Issue Topic	Management Action	Alternative A—No Action (Existing CBM Management)	Alternative B—CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred CBM Development Alternative
Air	Maximize the number of wells connected to each compressor	No	Yes	No	Yes	Yes
	Type of fuel to power compressors	Diesel, electric, or gas-fired	Gas-fired	Diesel, electric, or gas-fired	Gas-fired with electric boosters	Gas-fired or electric boosters
	Noise suppression required	No	No	No	No	Yes
	Implementation of a speed limit on CBM roads on BLM	No	Yes	No	Yes	Yes
	Air permit analysis	Yes	Yes	Yes	Yes	Yes
Coal Mines	Buffer zone (1 mile) around active coal mines	No	Yes	No	Yes	No
Coal Bed Methane	APD to be filed and approved prior to drilling	Yes	Yes	Yes	Yes	Yes
	CBM exploration limits	Yes	No	No	No	No
	CBM production limits	Yes	No	No	No	No
	Project Plan of Development required in consultation with tribes, surface owners, and other agencies	No	No	No	No	Yes
	Directional drilling required	No	Yes	No	Yes	Yes, unless exempted
	Multiple coal seams developed per well bore required	No	Yes	No	Yes	No

TABLE 2-2
ALTERNATIVE MANAGEMENT FOR CBM

Issue Topic	Management Action	Alternative A—No Action (Existing CBM Management)	Alternative B—CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred CBM Development Alternative
Coal Bed Methane, 'cont.	Simultaneous coal seam development required	No	Yes	No	Yes	No
	Wellhead camouflage required by BLM	No	No	No	Yes	Yes
Hydrology	Exploration water disposal	Untreated and stored, except for CX Ranch	Untreated and stored	Untreated surface discharge	Treated and conveyed	Exploration Water Management Plan required
	Production water disposal	CX Ranch only	Injection	Untreated surface discharge	Treated and conveyed	Various Methods Water Management Plan Required
	Site-specific Water Management Plan required	Yes	No	No	No	Yes
	Exploration/production water available for beneficial use	Yes	No	Yes	Yes	Yes
Realty	Corridors required	No	Yes	No	Yes	No, with surface owner consultation
	Powerline placement	Aboveground or buried	Buried	Aboveground or buried	Buried	Aboveground or buried
	Abandoned access roads	Agency/Surface Owner Discretion	Agency/Surface Owner Discretion	Agency/Surface Owner Discretion	Agency/Surface Owner Discretion	Agency/Surface Owner Discretion
	High fire danger restrictions	No	Yes	No	Yes	Yes
	Road use enforcement on BLM	No	Yes	No	Yes	No

TABLE 2-2
ALTERNATIVE MANAGEMENT FOR CBM

Issue Topic	Management Action	Alternative A—No Action (Existing CBM Management)	Alternative B—CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred CBM Development Alternative
Realty, 'cont.	Road placement on boundaries on BLM	No	Yes	No	No	Yes
Indian Trust and Native American Concerns	Buffer zone (2 miles) around reservations	No	Yes	No	Yes	No
	Monitoring wells required on BLM-administered minerals that abut reservations	No	No	No	No	Yes
	Resource protection protocols	No	No	No	No	Yes
	Air quality mitigation measures	No	No	No	No	Yes
	Special cultural resources protection measures	No	No	No	No	Yes
Vegetation	Commercially harvest ROW trees on BLM	No	Yes	No	No	Agency or Surface Owner Discretion
	Revegetate with early successional and late seral stage plants on BLM	Agency or Surface Owner Discretion	Agency or Surface Owner Discretion	Agency or Surface Owner Discretion	Agency or Surface Owner Discretion	Agency or Surface Owner Discretion
	Noxious weed control by operator	Yes	Yes	No	Yes	Yes

TABLE 2-2

ALTERNATIVE MANAGEMENT FOR CBM

Issue Topic	Management Action	Alternative A—No Action (Existing CBM Management)	Alternative B—CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources	Alternative C—Emphasize CBM Development	Alternative D—Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E—Preferred CBM Development Alternative
Wildlife	Wildlife surveys required by BLM	Yes	Yes	Yes	Yes	Yes
	Gray wolf, Canada lynx and grizzly bear surveys by BLM	As needed	As needed	As needed	As needed	Yes
	FWS biological opinion mitigation measures on BLM	No	Yes	Yes	Yes	Yes

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Air Quality *Existing air quality throughout most of the analysis area is in attainment with all ambient air quality standards. However, three areas have been designated as federal nonattainment areas where the applicable standards have been violated in the past: Lame Deer (PM_{10}—moderate) and Laurel (SO_2—primary), Montana; and Sheridan, Wyoming (PM_{10}—moderate).*					
	• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.	• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.	• Impacts under Alternative C are expected to be comparable to those describe for Alternative B but somewhat increased in severity due to the lack of control over operators choose for compressor fuel, reduced limits on compressor hook ups and the lack of enforceable control measures.	• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.	• Impacts under Alternative E would be comparable to those describe for Alternative B but are somewhat decreased in severity due to the use of gas-fired compressors and maximized compressor hook ups.
	• Maximum concentrations are expected to be below applicable state and National Ambient Air Quality Standards and PSD increments for near-field and far-field modeling.	• Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.		• Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.	• Although the air quality modeling shows the potential for certain standards to be exceeded, these impacts would not occur. The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies and therefore, residual impacts would remain within standards.
	• Potential direct impact on visibility within one mandatory federal PSD Class I, one Class II Area and the Class II Crow IR.	• Potential direct visibility impacts within seven mandatory federal PSD Class I Areas and the Northern Cheyenne Reservation. Additional visibility impacts to seven federal PSD Class II areas including the Crow and Fort Belknap Indian Reservations and three Wilderness Areas and one National Recreation Area and one National Monument.		• Potential direct visibility impacts within one mandatory federal PSD Class I Areas. Additional visibility impacts to three PSD Class II areas including the Crow Indian Reservation, one Wilderness Area and one National Recreation Area.	
	• Cumulative Impacts: – Potentially exceed the 24-hour PM_{10} NAAQS and PSD Class II increments south of Spring Creek Mine. – Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation. – Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area.	• Cumulative Impacts: – Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine. – Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine. – Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and at Washakie. – Potentially exceed PSD Class I increments for annual NO_2 on the Northern Cheyenne Reservation.	• Cumulative Impacts: – Same as Alternative B.	• Cumulative Impacts: – Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine. – Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine. – Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA.	• Cumulative Impacts: – Same as Alternative B.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Air Quality (cont'd.)					
	– Potential visibility impacts in 10 of 17 federal PSD Class I including the Crow and Fort Peck Indian Reservations. Additional visibility impacts to 7 of 13 PSD Class II sensitive areas including the Crow and Fort Belknap Indian Reservations.	– Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and Florence Lake in the Class II Cloud Peck Wilderness Area. – Potential visibility impacts in all federal PSD Class I and II sensitive areas including the N. Cheyenne, Fort Peck, Fort Belknap and Crow Indian Reservations.		– Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area. – Potential visibility impacts in 14 of 17 federal PSD Class I and all Class II sensitive areas including the N. Cheyenne, Fort Peck, Fort Belknap and Crow Indian Reservations.	
Cultural Resources *Approximately 73,600 cultural resource sites exist above known coal resources within the CBM emphasis area*					
	• An estimated 17 cultural resource sites could be identified during foreseen CBM activities. Of these only one or two would likely be eligible for the NRHP.	• The number of cultural resource sites identified would be practically the same for Alternatives B, C, D, and E based on the level of development, associated area of disturbance and minor differences between the alternative realty management actions. An estimated 630 cultural resource sites would be identified, of these sites, 120 to 170 could be found eligible for the NRHP.			
	• Cumulative Impacts: – An estimated 4,285 cultural sites would be identified. resulting in 430 to 612 sites likely eligible for the NRHP. – Identification of TCPs would increase with the development of CBM.	• Cumulative Impacts: – An estimated 5,135 cultural sites could be identified resulting in 515 to 735 sites that could be eligible for the NRHP. – Identification of TCPs would increase with the development of CBM.			

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Environmental Justice *Executive Order 12898 requires the non-discriminatory treatment of minority and low-income populations for projects under the jurisdiction of a federal agency*					
	• No adverse impacts with the exception of the undetermined Wyoming discharge influence. It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.	• No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana river's would constitute a potential environmental justice issue if unresolved. No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.	• Same as B except for adverse environmental effects would be expected from downstream water quality changes resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.	• No adverse human health or environmental effects would be expected to fall. disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.	• No adverse human health or environmental effects would be expected to fall. disproportionately on minority or low-income populations from this alternative. • Impacts would be mitigated as described under the *Environmental Justice* section, *Alternative A* and by implementation of the Project Plan of Development requirements.
Geology and Minerals *Montana's mineral resources are intimately tied to the complex geologic framework of the state. Locatable minerals and conventional Oil and Gas resources are found throughout the planning area in various recoverable and non-recoverable amounts*					
	• Federal: – Only minor loss of CBM during testing operations.	• Federal: – Irretrievable commitment of CBM resources from production, magnitude and complexity to reflect increase scale of development. – Potential mineral drainage between Federal mineral estates and state, fee and Tribal developments depending on site-specific conditions. – The presence of shallow CBM production could delay or interfere with certain types of seismic prospecting for conventional oil and gas reservoirs.	• Federal: – Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.	• Federal: – Same as Alternative B.	• Federal: – Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone. – Protection of potential Tribal CBM from drainage because of resource protection protocols.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Geology and Minerals (cont'd.)					
	• State: – Irretrievable commitment of CBM resources from CX Ranch Field production. – Delayed development or expansion of conventional oil and gas, coal mining, and surface mineral mining in minor instances with no interruption to existing activities. – CBM production dewatering at nearby coal seams, in rare occurrences can cause underground coal fires, methane seeps, and the liberation of methane to water wells.	• State: – Increased commitment of CBM resources due to increased level of CBM. – Mineral drainage and seismic interference issues same as for Federal under this alternative.	• State: – Same as Alternative B. – Potential mineral drainage between federal mineral estates and state, fee, or Tribal developments depending on site-specific conditions.	• State: – Same as Alternative B. – Potential mineral drainage between Federal mineral estates and state, fee, or Tribal developments depending on site-specific conditions.	• State: – Same as Alternative B. – Potential mineral drainage between federal mineral estates and state, fee or Tribal developments depending on site-specific conditions.
	• Cumulative Impacts: – Reduction in Coal resources from current and planned surface mine operations. – Potential CBM drainage along Wyoming Montana State Line.	• Cumulative Impacts: Increase in wells and infrastructure could impact existing mine expansion greater possibility of CBM drainage than A.	• Cumulative Impacts: Impacts increased over alternative B.	• Cumulative Impacts: – Same as Alternative B.	• Cumulative Impacts: Similar to Alternative B. – Potential mineral drainage between federal mineral estates and state, fee, or Tribal developments depending on site-specific conditions.
Number of wells predicted for analysis purposes:					
	• Federal/State – up to 925 CBM and 1720 Conventional wells.	• Federal/State – up to 18,275 CBM and 1720 Conventional wells.	• Federal/State – up to 18,275 CBM and 1720 Conventional wells.	• Federal/State – up to 18,275 CBM and 1720 Conventional wells.	• Federal/State – up to 18,275 CBM and 1720 Conventional wells.
	• Cumulative – up to 925 CBM and 1775 Conventional wells.	• Cumulative – up to 26,475 CBM and 1775 Conventional wells.	• Cumulative – up to 26,475.CBM and 1775 Conventional wells.	• Cumulative – up to 26,475 CBM and 1775 Conventional wells.	• Cumulative – up to 26,475 CBM and 1775 Conventional wells.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Hydrological Resources					
Surface water: The Tongue River has generally good quality water with a seasonal flow consistent from year to year and is frequently used for irrigation The Powder and Little Powder Rivers are characterized as having fair to poor quality water and can and do go dry, the waters are used for stock and limited irrigation.					
Groundwater: Regional groundwater is available in stream bottoms and alluvium, but becomes scarce away from the water course. Coal beds and interlayered sands are the most commonly used aquifers away from riparian areas. Groundwater quality is variable and effects taste and beneficial uses.					
Beneficial Reuse: The southeastern region of Montana is classified as a high plains desert environment and has experienced drought conditions for the past seven years					
	• Federal: – No impacts to surface or groundwater resources. – No beneficial reuse. • State: – Negligible increase in surface water flow and quality changes in the Tongue River. No change in other waterways. – Groundwater drawdown within the immediate vicinity of the CX Ranch. – Continued beneficial reuse of produced water at the CX Ranch.	• Surface Water – Surface water quality and quantity changes should be the same as Alternative A due to injection control.	• Surface Water – Surface water quality in some watersheds would be noticeably altered, resulting in restricted downstream uses. – Surface water flow would be considerably increased in some watersheds causing persistent riparian erosion, changes in watercourses and increased sedimentation.	• Surface Water – Surface water quality would not be altered due to required treatment prior to discharge – Surface water flow would be similar to Alternative C but with slight increase in volume due to reduced conveyance loss.	• Surface Water – Surface water quality would be slightly altered, however downstream uses would not be diminished. – Surface water flow would be moderately increased causing some riparian erosion, as well as increased sedimentation.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Hydrological Resources (cont'd.)					
		• Groundwater: – Groundwater will be drawn down over time in the Powder River Basin. – Isolated areas of development would experience an increased drawdown effect. – Immediate drawdown of coal seam aquifers would be minor and limited in horizontal extent. As CBM. production matures, coal seam aquifer drawdown could exceed 20 feet and reach as far as 4 to 5 miles from the edge of production. – No change in groundwater quality.	• Groundwater: – Drawdown same as Alternative B. – Alluvial groundwater quality would be altered due to infiltration of untreated production water.	• Groundwater: – Drawdown same as Alternative B – No groundwater quality impacts.	• Groundwater: – Drawdown would be the same as Alternative B. – Minor impacts to shallow groundwater quality from impoundment infiltration and surface discharge of some untreated production water.
		• Beneficial Reuse: – Same as Alternative A.	• Beneficial Reuse: – Same as Alternative A.	• Beneficial Reuse: – Increased availability of treated water for a variety of downstream and increased beneficial uses, estimated at 20% of production.	• Beneficial Reuse: – Required Water Management Plans from all operators would result in increased beneficial reuse of production water, estimate at 20%.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Hydrological Resources (cont'd.)					
.	• Cumulative Impacts: – Surface Water: Wyoming's discharge of CBM production water would increase surface water flow in Montana rivers depending on the season and watershed from minor to noticeable amounts. The surface water quality in the three-shared rivers between Montana and Wyoming would be slightly altered, however downstream uses will not be diminished. – Groundwater: Drawdown of groundwater from Wyoming CBM operations could extend several miles north into Montana. Groundwater quality in Montana would not be impacted by Wyoming CBM operations Drawdown from the CX Ranch may extent out several miles from the development.	• Cumulative Impacts: – Surface water flow and quality will be the same as Alternative A. – CBM production in Montana coupled to nearby Wyoming wells would noticeably increase the drawdown of groundwater aquifers.	• Cumulative Impacts: – Surface water quality in some watersheds would be noticeably altered, resulting in restricted downstream uses. – Surface water flow would be considerably increased in some watersheds causing persistent riparian erosion, changes in watercourses and increased sedimentation. – Impacts to groundwater drawdown, quality and beneficial reuse would be the same as in Alternative B.	• Cumulative Impacts: – Surface water quality would not be degraded and minor impacts from Wyoming would be diluted. – Surface water flow impacts would be similar to Alternative C with added volume due to reduced conveyance loss. – Impacts to groundwater drawdown and quality would be the same as in Alternative B. – Increased beneficial reuse, estimated at 20% of production.	• Cumulative Impacts: – Cumulative impacts would be dependent on WDEQ/MDEQ Water Quality Agreement and MDEQ non-degradation numerical standards. – Surface water quality would be slightly altered however downstream uses would not be diminished. – Surface water flows would be moderately increased in some watersheds and provide a source of flow in some rivers that would otherwise have gone dry seasonally. – Impacts to groundwater drawdown would be the same as Alternative B. – Shallow groundwater quality would be slightly altered due to impoundment infiltration and surface discharge of untreated production water. – Use of Water Management Plans and agency approval would result in increased beneficial reuse, estimated at 20%.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Hydrological Resources (cont'd.)					
	– Beneficial Reuse: Due to the increased water volumes from Wyoming's discharge there would be added opportunities for irrigation, stock watering and other uses from waterways, depending on the water quality.				
Indian Trust and Native American Concerns *Indian Trust Assets (ITAs) are official interests in assets held in trust by the federal government for Indian tribes or individuals. The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines ITAs as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians.*					
	• Federal: – No measurable impacts to Indian trust assets would occur from the CBM activities.	• Federal: – No surface water quality impacts foreseen. – Potential CBM drainage, dependent on specific site conditions, delayed by buffer zone. – Visibility impacts. – Wildlife Adaptation resulting in changes. – Potential cultural resource impacts to TCPs.	• Federal: – Potential for surface water quality and quantity impacts. – Potential CBM drainage, same as Alternative B. – Cultural Resource impacts same as B. – Visibility impacts.	• Federal: – Groundwater drawdown same as Alternative B. – Surface water quality impacts reduced by source treatment, increased availability of surface waters for irrigation and other beneficial uses. – Increased surface water flow could result in increase riparian erosion. – Potential CBM drainage, same as Alternative B. – Cultural Resource impacts same as B. – Visibility impacts.	• Federal: – Effects from groundwater drawdown mitigated because of resource protection protocols. Potential CBM drainage mitigated through the use of resource protection protocols. – Surface water quality impacts reduced with increased availability of surface waters for irrigation and other beneficial uses. – Increased surface water flow could increase riparian erosion. – Air Quality and visibility impacts alleviated through site specific permits and mitigation.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Indian Trust and Native American Concerns (cont'd.)					
	• State: – No measurable impacts to Indian trust assets would occur from the CBM activities.	• State: – Groundwater drawdown inward from reservation boundaries. – Limited short-term surface water impacts from spills and ruptures adjacent to Reservations. – Potential CBM drainage, dependent on specific site conditions, no delay due to adjacent development.	• State: – Groundwater drawdown same as Alternative B. – Surface water quality and quantity impacts. – Potential CBM drainage, same as Alternative B.	• State: – Groundwater drawdown same as Alternative B. – Surface water quality impacts reduced. – Potential CBM drainage, same as Alternative B.	• State: – Surface water quality protected.
	• Cumulative Impacts: – Reduction in Coal resources from the Absaloka Mine operation. – Surface water quality and quantity in the Tongue River would not be noticeable altered from Wyoming CBM development. – Drawdown of groundwater from Wyoming CBM operations has the potential to lower aquifer levels on the Crow Reservation. – Potential CBM drainage along southeastern corner of Crow Reservation from Wyoming operations.	• Cumulative Impacts: – Same as Alternative A. – Reduction of CBM resources if developed by Tribes, coupled with land disturbances and associated water impacts. – Changes in visibility. – Air Quality changes. – Potential air quality impacts to PSD class I 24-hour PM10 increments. – Potential air quality impacts to PSD Class I annual NO_2 increments.	• Cumulative Impacts: – Same as Alternative B.	• Cumulative Impacts: – Same as Alternative B except no potential air quality impacts to PSD Class I annual NO_2 increments.	• Cumulative Impacts: – Same as Alternative B.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Lands and Realty *Emphasis Area Land Ownership: Private 65%, Federal 20%, Tribal 10%, State 5%* *Total Acreage: 25,551,308*			*Miles of Road: Interstate, 440; US; 845; State, 430; Off-System,13,550* *Miles of Railroad: BNSF, 420; MT Rail Link, 190*		
	• Federal: – Minimal land area displaced by roads. – 400 acres disturbed short term during CBM exploration drilling.	• Federal: – Increase fire hazard and motorized access during 20-year lease. – Limit public access. – Disrupt active logging operations. – 25,600 short term acres and 15,250 long term acres disturbed during CBM development activities.	• All Federal and State impacts in Alternative B occur in Alternative C in addition to: – Impacts to adjacent mining operations The land use displacement from roads and utility lines lease operations is greatest in Alternative C. – Increased disturbances by CBM activities on private, state and federal estates. Short term disturbances 70,000 acres (Federal 32, 400, State 37,600); long term disturbances 47,600 acres (Federal 22,000, State 25,600).	• All Federal and State impacts in Alternative B occur in Alternative D in addition to: – Federal: Permanent loss of land use from road network.	• Federal and State: – Levels of disturbance would be slightly increased due to use of impoundments for production water management (Short term 74,000 acres, long term 44,000 acres). – Impacts from powerlines, roads, pipelines, and other utilities not requiring transportation corridors would be the same as Alternative C.
	• State: – Increased motorized access on the CX Ranch. – Increase motorized trespass. – 1,100 short term acres disturbed and 500 long term acres during CBM exploration and production activities.	• State: – Displace agricultural lands and disrupt irrigation system, increase cost of farm operation. – Reduced property values. – Displace community and residential growth. – Increase dust and noise impacts on residential use. – Increase cost of county road maintenance. – Increase long-term motorized access. – invite illegal trespass activities. – Increase forest pests. – Disrupt active logging operations. – Increase motorized trespass. – 29,750 short term acres and 17,700 long term acres disturbed during CBM development activities.			

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Lands and Realty (cont'd.)					
	• Total cumulative long term disturbance including all foreseen projects such as coal mine expansion, transportation etc. is estimated at 34,000 acres.	• Total cumulative acres disturbed long term including all foreseen projects 81,000	• Total cumulative long term acres disturbed would be approximately 102,300.		• Total cumulative long term acres disturbed would be approximately 92,200.
Livestock Grazing *AUM is equal to the amount of forage required to support one cow and her calf or 5 sheep for one month.* *The CBM Emphasis area has an estimated 1,207,400 acres of classified grazing and forested lands capable of supporting 323,941 AUMs.*					
	• Exploration wells located within BLM-permitted rangelands would result in the temporary loss of 69 AUMs. • State: – The exploration wells and production wells located at CX Ranch would result in a maximum construction loss of 272 AUMs on state and private rangelands combined. – Re-vegetating parts of the well pads during production would reduce the state-permitted losses to 194 AUMs.	• Exploration wells would result in the temporary loss of 413 AUMs (BLM 163, State 250). • Production wells would result in a maximum construction loss of 11,960 AUMs (BLM 4,770, State 7,190). • Re-vegetating parts of the well pads during production would reduce the losses to 6,904 AUMs (BLM 2,484, State 4,420). • If all Alternative requirements were utilized fully, the area of surface disturbances could be reduced by an additional 35 percent during construction and 40 percent during production primarily because of required transportation corridors.	• Impacts to livestock grazing would be similar to but slightly greater than those in Alternative B due to the discharge of untreated production water on to the ground resulting in increased erosion and no requirements for transportation corridors. • CBM discharge water could be used for livestock watering; increased erosion would result in increased surface disturbance, which could lead to disrupted grazing patterns, undermined fencing, and reduced forage; an increase of noxious weeds and a decrease in forage material could occur if discharged produced water is too high in saline content; and possible health effects to livestock if produced water that is unsuitable for livestock watering.	• Impacts would be similar to Alternative B with some exceptions: disturbed acreage would increase due to the piping of discharge water to the nearest disposal point. There would be a reduction to forage losses from increased land application of produced water; and there would be less soil and forage loss from erosion of soils. • Transportation corridor and road impact causing reductions of surface disturbance would be similar to Alternative B.	• Impacts to livestock grazing would be similar to Alternative B. Suitable CBM discharge water could be used for livestock watering. • Transportation corridor impacts would be the same as Alternative B. • Not as much forage would be lost under this alternative because increased land application of produced water would allow more growth. There would also be less soil and forage loss from soils erosion because more vegetation would hold the soils in place.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Paleontological Resources *Paleontological resources consist of fossil-bearing rock formations that underlie the entire planning area. Fossil outcrops are relatively rare throughout the emphasis area, but know areas are protected.*					
	• It is unlikely that any of the 1,500 short term acres disturbed during CBM development activities would contain noteworthy paleontological resources. The 575-acre Bridger Fossil Area ACEC (only paleontological resource) would not be disturbed. • Other impacts would include vandalism and removal of fossils by amateur fossil collectors resulting from minor increased accessibility to remote areas.	• Impacts for Alternative B, C, D, and E would be nearly the same based on level of disturbance, known locations of rich fossil areas, geological formation for paleontological features and protected ACECs. • There would be between 55,400 and 74,000 short term acres disturbed during CBM development activities increasing the chances that a minor fossil discovery would be made. Cumulative impacts would disturb an additional 33,400 acres increasing the likelihood of additional fossil discoveries. • Increased access would include increased vandalism and removal of fossils by amateur fossil hunters.			
Recreation *Montana's natural features offer a variety of year-round recreational opportunities*					
	• Minor loss of land for recreation purposes, and the disruption to recreation activities. • Exploratory activities such as drilling and testing would temporarily displace game species locally.	• Moderate loss of land for recreation purposes and the disruption to recreational activities. • Increased opportunities for access to remote areas.	• Impacts would be similar to Alternative B with the exception that increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.	• Impacts would be similar to Alternative B.	• Impacts would be similar to Alternative B with the exception that no requirements for transportation corridors would moderately increase access to remote areas.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Socio-Economics *Socio-economics address the changes in demographics; social organization including housing attitudes, and lifestyles; economics such as employment, unemployment and per capita income; and, government revenue sources including taxes, state oil and gas lease income, federal mineral revenues and private landowner revenues.*					
	• No social impacts (only small changes in employment, population, demand for services, etc.). • Small impact on economic conditions as a result of new production wells.	• Social impacts would include new jobs and new population moving to the area. • Economic impacts include generation of new personal and government income. • Additional disposal costs associated with injection of produced water. • Additional demands on public services.	• Social impacts same as Alternative B, with increase in impacts on lifestyles and values. • Economic impacts same as Alternative B, with increase in impacts to water resource users.	• Social impacts same as Alternative B, with small increase in impacts on lifestyles and values. • Economic impacts same as Alternative B, with small increase in impacts to water resource users.	• Social impacts same as Alternative B, with the exception that public burden to maintain roads may increase depending on landowner access decisions. • Economic impacts same as Alternative B, except that oil and gas income may be less depending on water treatment costs.
Soils *Montana has a wide mix of geologic parent material, which produces a vast array of different soil types*					
	• There would be minor occurrences of soil erosion, runoff, and sedimentation, mostly during construction activities. • Approximately 1,500 acres would be disturbed short term during CBM exploration and construction activities. • 500 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.	• Soil disturbances could be reduced by 35 percent or higher on a per well basis over Alternative A. CBM activities would result in 55,400 short term acres being disturbed. • 32,950 acres would be disturbed longer term during CBM production, with a majority of the land reclaimed after production is ceased. • No impacts would occur made to soils from CBM waters.	• CBM development activities would disturb corridors. Approximately 70,000 short term acres of disturbed surface area during construction activities. • Surface discharge and irrigation of produced water could result in approximately 47,600 acres disturbed in the long term.	• Impacts including levels of disturbance would be similar to Alternative B. • One favorable side effect would be that more water would be available for irrigation.	• Impacts would be similar to Alternative B. There would be a slight increase in the level of disturbance due to increased use of impoundments to contain produced water. Short term acres disturbed would be approximately 74,000 while long term would be 44,000. • Produced water would be available for beneficial use including irrigation. • No impacts are expected to occur on irrigated lands or soils

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Solid and Hazardous Wastes *Solid and hazardous wastes are under the jurisdiction of the MDEQ for RCRA wastes, MBOGC for RCRA exempt wastes, and the EPA for wastes generated on tribal lands*					
	• Typical solid waste refuse can be disposed of in local landfills. • Drilling mud and cuttings can be disposed of onsite with the landowner's permission. • Minor impacts would also occur from the use of pesticides and herbicides during access and construction activities. • Cumulative impacts from other foreseen projects would result in increased waste generated at moderate levels for commercial disposal.	• Impacts for Alternative B, C, D, and E would include increased quantities of waste requiring onsite disposal or transportation to commercial landfills. • Oil and gas developers are responsible for any damages to property, real or personal, resulting from the lack of ordinary care during operations. Operators are required to maintain SPCC plans and immediately remove and spilled or unused non-exempt wastes from the sites therefore no long term impacts to private, state or federal lands would occur from waste products associated with CBM development.			
Vegetation *Emphasis area acreage by land classifications, overlying known coal reserves: Grasslands, 3.55 million; Shrublands, 1.8 million; Forests, 1.36 million; Riparian Areas, 378,000; Barren Lands, 372,000; and Other Areas, 700,000*					
	• 1,144 acres of native habitat would be impacted under this Alternative, more than half (580 acres) in grasslands. • Potential minor loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be slightly impacted by disturbances.	• 55,400 acres of native habitat could be impacted short term under this Alternative, more than half (21,450 acres) in grasslands. • Potential moderate loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbances.	• 70,000 acres of native habitat could be impacted short term under this Alternative, more than half (27,300 acres) in grasslands. • If SAR values exceed 10 in water, riparian vegetation would be impacted, affecting as many as 3,535 acres of riparian habitat. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbance, SAR values, and water level changes, particularly inundation.	• Native habitat disturbances would be similar to those discussed under Alternative B. • Hydrology changes may affect as much as 2,776 acres of riparian habitat due to increased stream flow. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbance and water level changes, particularly inundation.	• Impacts would be similar to those for Alternative D, however no riparian habitat would be affected. Short term impacts would be slightly increased (74,000 acres) due to the use of impoundments for water management practices.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Visual Resource Management *Visual resources include Montana features such as landform, water, vegetation, color, adjacent scenery, uniqueness, structures and man-made features of aesthetic value*					
	• Federal and State: – Dust emissions would reduce visibility to a small degree near active field operations. – Well pads, roads, and compressors would disrupt the visual landscape. Semi-permanent structures are designed to blend into the surrounding environment. – Drill rigs, two-track trails, heavy road-making equipment, and generators would disrupt the visual landscape short-term.	• Federal: – There would be impacts to VRM BLM Class III and IV areas only. • Type of impacts common to Alternative A would occur with Alternative B, though at a scale commensurate with development. • View shed impacts from road network would last for 20 years and then reclaimed.	• Impacts common to Alternative B would occur with Alternative C, in addition to the following: • Above ground powerlines would greatly impact skyline and viewshed. • Visual impacts from roads and utility lines is greatest with this alternative until reclamation.	• Impacts common to Alternative B would occur with Alternative D, in addition to the following: • Production related roads that are not reclaimed and made part of the permanent road network would result in permanent visual impact.	• Impacts would be reduced from Alternative C by the mitigation measures in the Project Plan of Development for visual resources. • Impacts would be mitigated as described under the Alternative B, *Mitigation* subsection.
Wilderness Study Areas *There are 10 WSAs within the CBM emphasis area*					
	• BLM WSAs are closed to oil and gas leasing so there would be no direct impacts to WSAs. • Because there would be no production activities in BLM planning areas under this alternative, there would be no impacts.	• There would be no direct impacts to WSAs from CBM development.	• Same as Alternative B.	• Same as Alternative B.	• Same as Alternative B. • There would be no direct impacts to WSAs from CBM development. • Laws and regulations established for WSAs prohibit leasing of WSAs designated lands for resource extraction.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Wildlife *Mammal Species:* *- 10 bats* *- 8 shrews* *- 34 small mammals and lagomorphs* *- 17 predators* *- 4 big game*	*Bird Species:* *.- 32waterfowl* *- 33 shore & wading birds* *- 18 diurnal &* *- 11 nocturnal raptors* *- 8 gallinaceous* *- 8 wood peckers* *- 137 songbirds*	*Reptiles and Amphibian species:* *- 1 salamander* *- 4 frogs* *- 4 toads* *- 3 turtles* *- 2 lizards* *- 9 snakes*	*Species of Concern consist of 16 mammals, 6 reptiles and amphibians, and 22 birds, including:* *- Sage Grouse* *- Interior Least Tern* *- Gray Wolf* *- Canada Lynx* *- Grizzly Bear*	*- Mountain Plover - Bald Eagle* *- Peregrine Falcon* *- Black-tailed Prairie Dog* *- Black-footed Ferret*	
	• Direct and indirect impacts would occur at a level commensurate with the level of CBM development. • Direct impacts include habitat loss, death from vehicle collisions, and effects associated with greater human access into previously untraveled areas. • Indirect impacts on wildlife include disturbance and displacement, stress, power lines, noxious weed invasion, user-created roads, habitat fragmentation, water quality degradation from road runoff, and increased livestock grazing. • Indirect impacts on wildlife would occur on 33,840 to 84,000 acres. • Through mitigation, this Alternative would not directly impact any T&E listed wildlife species. Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, would be low because of the limited number of CBM wells permitted.	• Same as Alternative A but on a much larger scale. Twenty-five times as many wells, roads, and utility corridors as under Alternative A. • 6,680 miles of roads (2.9 to 8.8 miles per square mile). • 20,697 miles of utility corridors (9 to 27.1 miles per square mile). • Indirect impacts to wildlife on 884,000 to 4.7 million acres. • Additional types of impacts include loss of high value habitats such as prairie dog towns, sage grouse leks, and big game winter range. • Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal. Through mitigation, this Alternative would not directly impact any T&E listed wildlife species.	• Direct and indirect impacts would occur at a level commensurate with the level of CBM development. Indirect impacts to wildlife on 884,000 to 4.7 million acres from: – 9,018 miles of roads (3.9 to 11.9 miles per square mile). – 27,917 miles of utility corridors (12.2 to 36.6 miles per square mile). – Discharge of untreated CBM water into drainages would impact riparian and wetland habitat and associated species because of poor water quality and erosion. – Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water. • Through mitigation, this Alternative should not directly impact any T&E listed wildlife species.	• Impacts would be similar to Alternative B. • Discharged treated CBM water would erode riparian and wetland habitat. • Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water. • Through mitigation, this Alternative would not directly impact any T&E listed wildlife species. • Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, would occur at a level less than Alternative C. – Potential indirect impacts to T&E species from hydrology changes caused by increased water levels may impact nesting Interior Least Terns. If hydrology changes from surface water runoff, cause riparian vegetation changes, other T&E species may be impacted as well, such as nesting Bald Eagles.	• Direct and indirect impacts would occur similar to Alternative B. • Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres depending on development spacing. • Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal. • Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water. • Through implementation of WMPP & BO impacts to T&E listed species would be minimized. – Species of concern not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Wildlife (cont'd.)					
	• Species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment.	• Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, could occur. Impacts would be less than C or D with the restricting of utilities and roadways to the same corridor. • All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment and by increased access through increased roads.	• Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, are greater under this Alternative than any other because of the increased number of CBM wells permits.. • Potential indirect impacts to T&E species from changes in riparian habitat due to increased SAR values and hydrology are likely to occur under this Alternative. Bald Eagles and Interior Least Terns may also be affected if SAR changes affect forage fish. • Species of concern not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment or by changing streambed hydrology and increased SAR and salinity values in water and soil. • More water would be available for wildlife.	– Species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment or by changing streambed hydrology.	– These impacts would be less than alternative B, C and D through the implementation of the Wildlife Monitoring and Protection Plan. – More water would be available for wildlife as a result of CBM production.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Resource Topic	Alternative A No Action (Existing CBM Management)	Alternative B CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C Emphasize CBM Development	Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses	Alternative E Preferred CBM Development Alternative
Wildlife (Aquatic Resources) *Fish species vary between watersheds within the CBM emphasis area from 8 in the Little Big Horn River to 32 in the Musselshell River* *Special Status Aquatic Species:* *- Montana Arctic grayling* *- Pallid sturgeon* *- Warm spring zaitzevian riffle beetle*	• Minor short-term impacts on aquatic resources during CBM exploration and production may result from increased sediment delivery and its effects on aquatic habitat and organisms, possible impedance of fish movements, potential for accidental spills of petroleum products, and possibly increased fish harvest. • Relatively minor long-term increases in river flow and TDS concentration from production water discharge would not be expected to impact aquatic resources. • Conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges. • Impacts from CBM abandonment would be minor and subside over time.	• The same types of impacts described for Alternative A (No Action) would occur under Alternative B. • The scale of potential impacts associated with sediment delivery, fish movements, petroleum spills, and fish harvest would be much greater under Alternative B because of the development of over 18,000 CBM wells across a much larger geographic area. • No CBM production water would be discharged to surface drainages under Alternative B and there would be no potential for impacting aquatic resources from this particular activity. • Based on fish species present, fisheries management policies, fisheries resource values, and the projected intensity of CBM development, the drainages most sensitive to the effects of CBM development would be the Lower Bighorn, Upper Tongue, and Little Bighorn; then the Lower Tongue, Little Powder, and Rosebud; followed by the Mizpah. • The potential for affecting aquatic resources in sensitive drainages would be less under Alternative B than under Alternatives C or D.	• The same types of impacts described for Alternative A would occur under Alternative C, but they would occur on a far greater scale because of the development of over 18,000 CBM wells. • A total of 0.67 billion cubic feet of untreated CBM production water would be discharged to drainages each year. Resultant flow and TDS increases could potentially impact aquatic organisms, especially in smaller drainages during dry times of the year. • Conditions of MPDES Permits would provide legally enforceable assurances preventing the degradation of water quality, aquatic resources, and the beneficial uses of receiving waters. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative C than under Alternatives B or D.	• The same types of impacts described for Alternative A would occur under Alternative D, but they would occur on a far greater scale because of the development of over 18,000 CBM wells. • The annual discharge of 2.24 billion cubic feet of treated CBM production water through pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year. • The treatment of CBM production water prior to its discharge would greatly reduce the potential for elevated TDS and salinity impacts on aquatic resources. • MPDES Permits would provide legal assurances that water quality, aquatic resources, and beneficial uses of receiving waters would be protected. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative D than under Alternative B but less than under Alternative C.	• Same as Alternative B. • Implementation of wildlife monitoring and Protection Plan would reduce impacts to aquatic habitat wildlife and invertebrates.

CHAPTER 3

AFFECTED ENVIRONMENT

MONTANA

CHAPTER 3: AFFECTED ENVIRONMENT

Introduction

This chapter contains a description of the natural resources, economic, and social conditions found in the planning area and within the two Indian reservations adjacent to the planning area.

Air Quality

The air quality of any region is controlled primarily by the magnitude and distribution of pollutant emissions and the regional climate. The transport of pollutants from specific source areas is affected by local topography and meteorology. In the mountainous western U.S., topography is particularly important in channeling pollutants along valleys, creating upslope and downslope circulations that may entrain airborne pollutants, and blocking the flow of pollutants toward certain areas. In general, local effects are superimposed on the general synoptic weather regime and are most important when the large-scale wind flow is weak.

Topography

The coalbed methane (CBM) emphasis area is located in the northern portion of the Powder River Basin of the northwestern Great Plains Steppe in southeastern Montana. The Great Plains Steppe is a large physiographic province extending throughout most of eastern Montana, Wyoming, and Colorado, as well as portions of western North and South Dakota, Nebraska, Kansas, and the Oklahoma panhandle. The topography of the CBM emphasis area varies from moderately steep to steep mountains and canyons in the western portions, to rolling plains and tablelands of moderate relief (with occasional valleys, canyons, and buttes) in the eastern regions. Elevations generally range from about 3,000 to 7,000 feet above mean sea level, with mountain peaks rising to over 10,000 feet in the southwestern portion of the CBM emphasis area.

Climate and Meteorology

Because of the variation in elevation and topography throughout the CBM emphasis area, climatic conditions will vary considerably. Most of the area is classified as a semiarid cool steppe, where evaporation exceeds precipitation, with relatively short warm summers and longer cold winters. On the plains, average daily temperatures typically range between 5 to 10 (low) and 30 to 35 (high) degrees Fahrenheit in mid-winter, and between 55 to 60 (low) and 85 to 90 (high) degrees Fahrenheit in mid-summer. The frost-free period (at 32 degrees Fahrenheit) generally occurs for 120 days between late May and mid-September. The annual average total precipitation is nearly 12 to 16 inches, with 36 to 60 inches of total annual snowfall. Temperatures will generally be cooler, frost-free periods shorter, and both precipitation and snowfall greater at the higher elevations, including the mountains in the southwest portion of the CBM emphasis area.

Prevailing winds will occur from the southwest, but local wind conditions will reflect channeling (mountain and valley flows) due to complex terrain. Nighttime cooling will enhance stable air, inhibiting air pollutant mixing and enhancing transport along the valley drainages. Dispersion potential will improve along ridge and mountain tops, especially during winter-spring weather transition periods and summer convective heating periods.

Existing Air Quality

Although site-specific air quality monitoring is not conducted throughout most of the CBM emphasis area, air quality conditions are generally good and well within existing air quality standards, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches). Existing air quality throughout most of the analysis

What has Changed in Chapter 3 Since the Draft EIS?

Chapter 3 describes the affected environment. The planning area did not change between the Draft and Final EIS; however this chapter was changed to include a clearer explanation of the current air quality and hydrologic conditions, and to expand on the Geology and Minerals, and Native American sections. The Air Quality section was enhanced with modeling data. Clearer text was added to the Hydrology section to explain the complex relationships between ground and surface water. The Geology and Minerals section was expanded to include more maps of the emphasis area and a stand alone discussion of the geology. The Native American section was expanded based on the completion of the Crow Tribe of Indians and Northern Cheyenne Tribal Reports. Text throughout the chapter was revised for simpler presentation.

TABLE 3-1
ASSUMED BACKGROUND CONCENTRATIONS OF REGULATED AIR POLLUTANTS (μg/m^3)

Pollutant	Averaging Time	Background Concentrations[1]	National Ambient Air Quality Standards	Montana Ambient Air Quality Standards
Carbon monoxide (CO)	8-hours	6,600	10,000	10,000
	1-hour	15,000	40,000	26,000
Nitrogen dioxide (NO_2)	Annual	11	100	100
	1-hour	117	n/a	566
Sulfur dioxide (SO_2)	Annual	16	80	60
	24-hours	89	365	260
	3-hours	325	1,300	n/a
	1-hour	666	n/a	1,300
$PM_{2.5}$	Annual	8	15	n/a
	24-hour	20	65	n/a
PM_{10}	Annual	30	50	50
	24-hour	105	150	150

Source: Argonne (2002)
Notes:
[1] Background numbers are from Montana DEQ (MDEQ 2002) Modeling protocol (Argonne 2002)
μg/m^3 = micrograms per cubic meter
n/a = not applicable
PM_{10} fine particulate matter less than 10 microns in effective diameter
$PM_{2.5}$ fine particulate matter less than 2.5 microns in effective diameter

area is in attainment with all ambient air quality standards, as demonstrated by the data presented in Table 3-1. However, three areas have been designated as federal nonattainment areas where the applicable standards have been violated in the past: Lame Deer (PM_{10}—moderate) and Laurel (SO_2—primary), Montana; and Sheridan, Wyoming (PM_{10}—moderate). Anticipated existing contributors to pollutants within the region include the following:

- Emissions from oil and gas developments, e.g., natural gas-fired compressor engines (primarily carbon monoxide [CO] and oxides of nitrogen [NO_x])
- Coal mining
- Coal-fired power plants
- Gasoline and diesel vehicle tailpipe emissions of combustion pollutants (volatile organic compounds [VOC], CO, NO_x, fine particulate matter less than 2.5 microns in effective diameter [$PM_{2.5}$], inhalable particulate matter less than 10 microns in effective diameter [PM_{10}], and sulfur dioxide [SO_2]).
- Dust (particulate matter) generated by vehicle travel on unpaved roads and windblown dust from neighboring areas and road sanding during the winter months.
- Transport of air pollutants from emission sources located outside the region.

As part of the Air Quality Impact Assessment – Technical Support Document (Argonne 2002), monitoring data measured throughout southeastern Montana and northeastern Wyoming were assembled and reviewed. Although monitoring is primarily conducted in urban or industrial areas and may be relatively higher than expected in the rural areas of the state, the data is considered representative of existing background air pollutant concentrations throughout the CBM emphasis area. These values, presented in Table 3-1, reflect conditions where existing air pollutant sources (e.g., range fires, agricultural operations, etc.) may be impacting ambient air concentrations and so were deemed to be reasonable for use to define existing background conditions in the air quality impact analysis. The assumed background pollutant concentrations are below applicable National Ambient Air Quality Standards (NAAQS) and applicable

Montana Ambient Air Quality Standards (MAAQS) for all pollutants and averaging times, as shown in the table.

Regulatory Framework

The National and Montana Ambient Air Quality Standards set the absolute upper limits for specific air pollutant concentrations at all locations where the public has access. The analysis of the proposed Alternatives must demonstrate continued compliance with all applicable local, state, tribal, and federal air quality standards. Montana's ambient standards are not applicable within the reservation but apply to adjacent areas off the reservation. Finally, although the U.S. Environmental Protection Agency (EPA) recently revised both the ozone (8-hour) and $PM_{2.5}$ NAAQS, these revised limits will not be affective until the Montana State Implementation Plan (SIP) is formally approved by EPA.

Given most of the CBM emphasis area's current attainment status, future development projects (including any proposed Alternative) which have the potential to emit more than 250 tons per year of any criteria pollutant (or certain listed sources that have the potential to emit more than 100 tons per year) would be required to undergo a regulatory Prevention of Significant Deterioration (PSD) Increment Consumption analysis under the federal New Source Review and permitting regulations. Development projects subject to the prevention of significant deterioration (PSD) regulations must also demonstrate the use of Best Available Control Technology (BACT), and show that the combined impacts of all PSD sources will not exceed the allowable incremental air quality impacts for NO_2, SO_2, and PM_{10}. A regulatory PSD Increment Consumption analysis may be conducted as part of a major New Source Review, or independently. The determination of PSD increment consumption is a legal responsibility of the applicable air quality regulatory agencies, with EPA oversight. Finally, an analysis of cumulative impacts due to all existing sources, and the permit applicant's sources, is also required during New Source Review to demonstrate that applicable ambient air quality standards will be met during the operational lifetime of the permit applicant's operations.

Mandatory federal Class I areas were designated by the U.S. Congress on August 7, 1977, which included wilderness areas greater than 5,000 acres in size and national parks greater than 6,000 acres in size on that date. In addition, the Fort Peck and Northern Cheyenne tribes have redesignated their lands as PSD Class I. The allowable incremental impacts for NO_2, SO_2, and PM_{10} within these PSD Class I areas are very limited. Most other locations in the country are designated as PSD Class II areas with less stringent requirements. Table 3-2 shows the relevant ambient air quality standards and PSD increment values.

This NEPA analysis compares potential air quality impacts from the proposed Alternatives to applicable ambient air quality standards and PSD increments, but comparisons to the PSD Class I and II increments are intended to evaluate a threshold of concern for potential impacts, and do not represent a regulatory PSD Increment Consumption Analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. The Montana DEQ will perform the required regulatory PSD increment analysis during the new source review process. This formal regulatory process will include analysis of impacts on Class I and II air quality areas by existing and proposed emission sources. The activities are not allowed to cause incremental effects greater than the stringent Class I thresholds to occur inside any PSD Class I Area. Stringent emission controls (BACT – Best Available Control Technology) and emission limits may be stipulated in air quality permits as a result of this review, or a permit could be denied.

In addition, sources subject to the PSD permit review procedure are required to demonstrate impacts on Air Quality Related Values (AQRV) will be below Federal Land Managers' "Limits of Acceptable Change." The AQRVs to be evaluated include degradation of mountain lakes from atmospheric deposition (acid rain), visibility impacts, and effects on sensitive flora and fauna in the Class I areas. The Clean Air Act (CAA) also provides specific visibility protection procedures for the mandatory federal Class I areas designated by the U.S. Congress on August 7, 1977, which included wilderness areas greater than 5,000 acres in size, as well as and national parks and national memorial parks greater than 6,000 acres in size as of that date. The Fort Peck and Northern Cheyenne Tribes have also designated their lands as PSD Class I, although the national visibility regulations do not apply in these areas. Finally, the CAA directs the EPA to promulgate the Tribal Authority Rule, establishing tribal jurisdiction over air emission sources on both trust and fee lands within the exterior boundaries of tribal lands. Pursuant to this rule, Native American tribes may submit a "Treatment as a State" application to the EPA, requesting that they be treated in the same manner as a state under the CAA, including Section 105 grants and formal recognition as an affected "state" when permits are written for sources within 50 miles of tribal land boundaries (per 40 CFR 70.8 and 71.2). Also, the tribes can be delegated authority to establish an Operating Permits Program under Title V of the CAA, in order to issue permits for air pollutant emission sources located within the exterior boundaries of tribal lands.

TABLE 3-2
APPLICABLE AMBIENT AIR QUALITY STANDARDS AND PSD INCREMENT VALUES (μg/m^3)

Pollutant	Averaging Time [1/]	National Primary	National Secondary	Montana	PSD Class I Increments	PSD Class II Increments
Carbon monoxide	8-hours	10,000	10,000	26,000	n/a	n/a
	1-hour	40,000	40,000	40,000	n/a	n/a
Nitrogen dioxide	Annual	100	100	100	2.5	25
	1-hour	n/a	n/a	566	n/a	n/a
Ozone	8-hours	157	157	n/a	n/a	n/a
	1-hour	235	235	196	n/a	n/a
Sulfur dioxide	Annual	80	n/a	60	2	20
	24-hours	365	n/a	260	5	91
	3-hours	n/a	1300	n/a	25	512
	1-hour	n/a	n/a	1300	n/a	n/a
PM$_{2.5}$	Annual	15	15	n/a	n/a	n/a
	24-hours	65	65	n/a	n/a	n/a
PM$_{10}$	Annual	50	50	50	4	17
	24-hours	150	150	150	8	30
Lead	Quarterly	1.5	1.5	1.5	n/a	n/a

Source: Argonne (2002)
Notes: μg/m^3 = micrograms per cubic meter
[1] Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.
n/a = not applicable.

Cultural and Historical

Cultural resources consist of the material remains of—or the locations of—past human activities, including traditional cultural properties (TCP) to both past and contemporary Native American Communities. Cultural resources within the planning area represent human occupation throughout two broad periods: the prehistoric and the historic. The prehistoric period is separated into the Paleo-indian Period (circa 10,000 B.C. to 5,500 B.C.), the Archaic Period (circa 5,500 B.C. to A.D. 500), the Late Prehistoric Period (circa A.D. 500 to 1750), and the Proto-historic Period (circa 1750 to 1805+). The prehistoric period began with the arrival of humans to the area around 12,000 years ago, and is generally considered to have ended in 1805 when the Lewis and Clark Expedition passed through the area. Cultural resources relating to the prehistoric period may consist of scatters of flaked and ground stone tools and debris, stone quarry locations, hearths and other camp debris, stone circles, wooden lodges and other evidence of domestic structures, occupied or utilized rock shelters and caves, game traps and kill sites, and petroglyphs, pictographs, stone cairns and alignments, and other features associated with past human activities. Some of these sites contain cultural resource features that are in buried deposits.

The historic period is characterized by the arrival of fur traders and explorers to the area and is the start of the period for which written records exist. Cultural resources within the planning area that are associated with the historic period consist of fur trading posts, homesteads, settlements, historic emigrant and stage trails, Indian war period battle sites, ranch development, railroad installations, mining operations, oil and gas fields, and Native American sites.

The following areas are designated cultural Areas of Critical Environmental Concern (ACECs):

- Powder River Resource Management Plan (RMP) area—Battle Butte ACEC is a 120-acre site in Rosebud County. Reynolds Battlefield ACEC is a 336-acre site in Powder River County.
- Billings RMP area—Pompeys Pillar is a 470-acre site in Yellowstone County. Castle Butte ACEC is a 185-acre site in Yellowstone County. Petroglyph Canyon is a 240-acre in Carbon County. The Stark Site is an 800-acre site in western Musselshell County. Weatherman Draw is a 4,268-acre site in Carbon County.

Each of these ACECs has their own management plans that include restrictions on activities and development (BLM 1999a). Two additional cultural resource sites, the Mill Iron and Powers-Yonkee sites in the Powder River RMP area, have been designated Special Management Areas (SMAs) that also have their own management plans that include restrictions on activities and development.

There are off-reservation TCPs in southeastern Montana that are currently important to Native Americans. These include ceremonial, homestead, burial, cairn, rock art, fasting, medicine wheel, medicine lodges, settlements, stone rings, Sun Dance lodges, communal kills, and battle/raiding sites as well as rivers, springs, spirit homes, and vision quest spiritual locations and landscapes that include plant collecting areas, fossil and mineral locations, paint sources, and water. For the Northern Cheyenne these include TCPs in or near Deer Medicine Rocks, Little Bighorn Battlefield, Medicine Rock Site, Chalk Buttes, locations in and around Custer National Forest, and the Tongue River Valley. Detailed descriptions of these locations and their importance to the Northern Cheyenne can be found in the "The Northern Cheyenne Tribe and its Reservation" (Northern Cheyenne Tribe 2002). Crow TCPs include the west slopes of the Pryor Mountains, Tongue River Valley, Chalk Buttes, Broadus, and Big Horn Mountains (Crow Tribe 2002).

The existence of cultural resources within a specific location is determined through examination of existing records, on-the-ground surveys, and subsurface testing of areas that are proposed for disturbance on federal and state lands. Cultural resources are evaluated if federal or state minerals are involved and, for traditional cultural properties, consultation with appointed tribal government representatives who have knowledge of and can address issues of traditional cultural significance. Section 106 of the National Historic Preservation Act (NHPA) requires an inventory of cultural resources if federal involvement is present either in terms of surface or mineral estate, federal funds, federal grant, or federal license. Consultation with federally recognized Native American tribes must also be conducted to evaluate TCPs. The Montana State Historical Preservation Officer (SHPO) maintains a register of all identified sites within each of Montana's counties as well as all sites that are listed or eligible for listing on the National Register of Historic Places (NRHP). Table 3-3 contains information about the number of cultural resource sites that have been identified to date by SHPO for each of the counties within the planning area. Also included in this exhibit is information about the number and density of sites that are known to be located within the current area of CBM production.

A complete listing of SHPO recorded sites can be found in "An Ethnographic Overview of Southeast Montana" (Peterson and Deaver 2001) along with a listing of sites mentioned in literary sources, potential homestead locations, and spring locations.

TABLE 3-3
CULTURAL RESOURCE SITES IDENTIFIED BY SHPO WITHIN EACH COUNTY OF THE PLANNING AREA

RMP Area County	Number of Cultural Resource Sites Identified in Surveys	Number of Acres Surveyed	Number of Sites Per Surveyed 1,000 Acres	Number of Acres Within the County	Percent of County Surveyed	Extrapolated Number of Sites In the County	Extrapolated Number of NRHP Eligible Sites
Powder River RMP Area							
Carter	444	122,652	3.62	2,132,128	5.7	7,753	779-1,121
Powder River	1,460	91,500	15.96	2,109,880	4.3	33,664	3,386-4,869
Custer	700	42,211	16.58	2,425,137	1.7	40,217	4,045-5,817
Rosebud	1,465	196,576	7.45	3,213,997	6.1	23,953	2,409-3,464
Treasure	101	17,051	5.92	629,224	2.7	3,727	374-539
Subtotal	*4,170*	*469,990*	*8.87*	*10,510,366*	*4.5*	*109,314*	*10,993-15,810*
Billings RMP Area							
Wheatland	137	5,694	24.06	913,079	.6	21,969	2,210-3,177
Sweet Grass	209	24,866	8.41	1,190,833	2.0	10,009	1,006-1,447
Stillwater	257	9,417	27.29	1,154,243	.8	31,499	3,168-4,556
Carbon	919	34,326	26.77	1,319,367	2.6	35,326	3,553-5,109
Golden Valley	97	9,309	10.42	752,094	1.2	7,837	788-1,133
Musselshell	482	33,267	14.49	1,196,032	2.8	17,329	1,743-2,506
Yellowstone	801	36,700	21.83	1,693,991	2.2	36,971	3,719-5,347
Big Horn**	1,819	278,802	6.52	3,208,115	8.7	20,930	2,105-3,027
Subtotal	*4,721*	*432,381*	*10.92*	*11,427,754*	*3.8*	*181,870*	*18,292-26,302*
Additional Counties							
Blaine	1,111	89,285	12.44	2,711,111	3.3	33,738	3,394-4,880
Gallatin	810	95,682	8.47	1,682,769	5.7	14,252	1,433-2,061
Park	614	43,570	14.09	1,799,785	2.4	25,363	2,551-3,668
Subtotal	*2,535*	*228,537*	*11.09*	*6,193,665*	*3.7*	*73,353*	*7,378-10609*
Total for CBM Emphasis Area*	11,426	1,130,908	10.10	28,131,785	4.0	364,537	36,663-52,721
CBM Area Above Known Coal Reserves			10.10	7,286,144		73,590	7,396-10,648

*CBM Production Area includes portions of Big Horn, Rosebud, and Powder River counties where active coal mining is currently conducted and where non-federal CBM production wells currently exist.

**Also includes portion of Powder River Basin RMP area.

Approximately 4 percent of the planning area has been surveyed for cultural resources resulting in a total of 11,426 cultural resource properties or sites being identified. This represents an average density of 10.10 sites per 1,000 surveyed acres or, assuming an equal distribution of sites, one site per 98.97 surveyed acres. Assuming this data across the total acreage contained within the counties of the planning area yields a total of 364,535 cultural resource properties or sites that might be expected. A total of 3,297 sites have been identified in those portions of Big Horn, Rosebud, and Powder River counties that represent the area with the greatest potential for CBM production, with an average density of 6.27 sites per 1,000 surveyed acres or, assuming an equal distribution of sites, one site per 159.49 acres. Extrapolated data yields a total of 16,942 sites that might be expected within the CBM production area.

The site densities estimated above are, of course, extrapolated assuming a consistent distribution within each county. This analysis is only valid for general site number estimates and not for site location or type of site. Sites cluster based on a host of additional site location information such as geographical location, access to water, plant, animal and other resources, view and visibility, exposure, etc. The type of site is directly related to site location depending on the activity conducted at the site. Easily accessible geographical classification and other associated site data did not exist at the time this report was prepared and the estimates provided are the best that can be made at this time.

The data used for this analysis was based, in part, on surveys conducted more than 20 years ago. Standards for survey and recordation have changed and it is likely that the actual number of sites and their relative density is higher than indicated on Table 3-3. Despite these anticipated differences the general findings of this analysis are still valid.

Geology and Minerals

Montana is the site of the juxtaposition of the Great Plains with the Rocky Mountains. The rocks at the surface vary from the ancient metamorphic and igneous complexes forming the cores of some mountains to Recent sediments in the major river valleys of the state. Geology of Montana plays an indispensable role in forming the mineral resources, visual resources, and water resources of the state. The geologic history of the state has been a series of major structural events in the tectonics, or continent building of North America.

Map 3-1 is the Tectonic Element Map of the State of Montana. The map shows the locations of important basins such as the Big Horn and Williston that have trapped sediment containing coal, oil, and natural gas. The map also locates mountain ranges such as the Crazy Mountains and Black Hills that served as sources for some of the sedimentary units. Several tectonic elements will be discussed in detail including those features that affect the state's resources – The Powder River Basin, The Big Horn Basin, Big Horn Mountains, the Bull Mountains Basin, and others. These major tectonic elements control the porous reservoirs that hold the usable water, oil, and natural gas. They also control the impermeable barriers to fluid movement. These elements also control the local folds and faults that form the oil and gas fields of the state.

Montana's basins have accumulated sediments several miles in thickness; these sands, shales, and limestones form the source and reservoirs of Montana's fossil energy reserves – crude oil, natural gas, coal, and coal bed methane (CBM). In these basins, ancient sediments were buried to great depths within the earth where heating and increased pressure formed the fuels from the raw plant materials trapped in the sediments. The sedimentary basins also hold a significant portion of the water resources of the state; in the deep parts of these basins the water is generally salty while the shallower parts of these basins there is fresh water of meteoric origin.

Map 3-2 presents the statewide outcrop geology. The map emphasizes broad basin features underlying the Great Plains in contrast to the intensely contorted structures under the many mountain areas. The basins mentioned above as likely to contain CBM resources, such as the Powder River Basin, can be seen as broad expanses of similar outcrop. In the case of the Powder River Basin, rocks at the surface are all coal-bearing Tertiary formations except for the scattered Quaternary age Alluvium in stream and river valleys. Other basins contain coal-bearing sediments of Cretaceous age. The presence of large volumes of suitable coal is vital for predicting CBM development.

CBM is the focus of this EIS; it is important to recognize that the resource is intimately associated with coal deposits. The methane gas is generated by the coal deposit both under thermogenic (heat-driven) and biogenic (microbe-driven) conditions. At the same time, the methane is trapped in the coal seams by the pressure of groundwater. Releasing the pressure of groundwater from the coal aquifers liberates methane, allowing it to be produced and sold. The magnitude of the CBM resource is determined by coal type and volume; the location of coal reserves will predict the location of Montana's CBM resources.

Map 3-3 is the statewide coal occurrence map. The map displays the extent of coal deposits that support mines and are expected to support projected CBM development. The geology of Montana has given rise to several different kinds of coal; the most important differentiator is coal rank or thermal maturity. As coal is buried or otherwise heated, the raw plant material is gradually converted from complex carbon compounds to simple compounds and elemental carbon. Map 3-3 highlights coal rank or maturation ranging from lignite, sub-bituminous, high-volatile bituminous, medium-volatile bituminous, low-volatile bituminous, and anthracite coals (Leythaeuser and Welte 1969). The areas of interest are the Powder River Basin, Bull Mountain Basin, and Blaine County, which contain mostly sub-bituminous coal that has not reached a high degree of maturation. Also of interest for CBM are the Big Horn Basin and the counties of Park and Gallatin that contain medium and high volatile bituminous coal of slightly higher maturity.

According to the Montana Board of Oil and Gas Conservation (MBOGC) records, CBM has been produced only in the CX Ranch field in the Montana portion of the Powder River Basin since April 1999. Exploration solely for CBM first happened in the Montana Powder River Basin in December 1990 in the area of CX Ranch. However, the first CBM exploration in the state was in August 1990 in the Big Horn Basin where CBM was tested but never sold. In many parts of the state, coals are aquifers that contain significant amounts of groundwater and are used by residents for water needs. In order to produce the methane in the Montana part of the Powder River Basin, groundwater must be drawn off the coal aquifer. Unless groundwater is produced from the coals, methane will not be produced; water production cannot be avoided during CBM development. This is the central conflict between CBM and traditional uses of the land; when CBM is produced, local coal aquifers are partially depleted. Depending on the area, this depletion may extend beyond the CBM producing field boundaries.

Regional Geology

The planning area of the EIS centers on the Powder River RMP area and the Billings RMP area. The planning area contains three major basinal features – Powder River, Big Horn, and Bull Mountains – and surrounding uplifted areas. All three basins were formerly broad shelfs until Laramide tectonics caused uplift in the surrounding areas. This era of uplift and mountain building contributed to sedimentary deposition and subsidence within the basins during the Late Cretaceous and Early Tertiary. The Bull Mountains Basin and Powder River Basin were one continuous basin during the depositional periods of the Cretaceous and Early Tertiary. It was post-depositional tectonics that divided the two (Stricker, 1999). The asymmetric basins are the result of a combination of sedimentary and structural subsidence with most of the fill consisting of the Fort Union Formation. The Fort Union Formation also contains most of the coals occurring in these three basins.

The Powder River Basin in its entirety covers approximately 12,000 square miles with the smaller portion in Montana (Ellis et al., 1998). The Powder River Basin is bounded to the west by the Bighorn Uplift, to the southwest and south by the Casper Arch, Laramie Mountains, and Hartville Uplift; and to the east by the Black Hills Uplift. The Miles City Arch and the Cedar Creek Anticline to the north essentially separate the Powder River Basin from the Williston Basin.

Coal has been mined in the Powder River Basin since 1865 and large-scale strip-mining has been underway since the mid-1960s when demand increased for relatively clean-burning coals (Flores and Bader 1999). Conventional oil and gas have been exploited in the Powder River Basin for more than 50 years while CBM has been only lately developed with major activity beginning in 1997 (Rice et al. 2000).

Map 3-4 depicts the outcrop geology of the Montana portion of the Powder River Basin. The map illustrates the broad geometry of the basin with the youngest Tertiary strata (Wasatch Formation) preserved in the deepest part of the basin just north of the Wyoming-Montana state line. The broad bands of the Tongue River and Lebo/Tullock members throughout most of the basin attest to the shallow dips to the east and north edges of the basin. The narrow outcrop bands on the west limb of the basin indicate that the basin is somewhat asymmetrical with steeper dips on the western side.

Map 3-5 portrays the distribution of water wells, the prospective CBM areas, and existing CBM production within the Montana portion of the Powder River Basin. The map was constructed from information in the MBMG Map 60 (Van Voast and Thale, 2001) and emphasizes those areas with thick, sub-bituminous and bituminous coal reserves. Coals are both water reservoirs and gas reservoirs and as such, CBM production will affect local aquifers and even surface water. CBM development is expected to be concentrated in the southern portion of the PR RMP area although coals exist over most of the basin and CBM coverage could prove to be greater. The water wells shown in the map could be at risk to drawdown impact from CBM development, especially those water wells completed in coal aquifers. Those aquifers at risk to CBM impact are described in the Hydrology section.

Stratigraphy

The stratigraphy of the planning area describes the age, composition, and continuity of sedimentary rocks. The sedimentary strata of the planning area extend backward in time from recent age alluvium found in stream valleys, to strata at the surface that is largely Tertiary and Cretaceous. These older formations were deposited during the Laramide orogeny that gave rise to most of the uplifted areas in Montana. Though the area contains significant thicknesses of older formations, the Tertiary age basin fills are of particular interest for coal, CBM, and groundwater production (Ellis et al. 1998). Conventional oil and natural gas occur in the older, pre-Laramide section but most coals of interest in the Powder River Basin are found in the Early Tertiary units. See Figure 3-1 for a stratigraphic interpretation of the regional geology of the Powder River Basin.

Figure 3-2 is a stratigraphic column of Upper Cretaceous and Lower Tertiary sediments in the Montana Powder River Basin. The stratigraphic column shows the continuous development of several thousand feet of sediments that include widespread sands, coals and fluvial, fine-grained sediments. The major formations are named along with major coal seams that are discussed in greater detail elsewhere. Geologic formations found at the surface of the Powder River Basin consist largely of the several members of the Paleocene Fort Union Formation, as well as the overlying Wasatch Formation in a small corner of the basin (Rice et al. 2000). The Fort Union Formation contains the coal, seams of interest within the Montana portion of the Powder River Basin. These coals seams function as the source of the CBM, as well as aquifers carrying groundwater of varying quantity and quality. In the Powder River Basin coal seams range in depth from the surface to approximately 900 feet deep. Coal seams vary in thickness from over 50 feet and can form aggregate thicknesses over 100 feet. Coal seams in the Fort Union do not have significant matrix porosity and permeability (Gray 1987); they can act as aquifers because fluids such as water and methane are contained within the coal's fracture system, known as cleat (Montgomery et al. 2001). The fractures accumulate the fluids and allow the fluids to move horizontally and vertically.

Sediments in the Powder River Basin

Deep Formations

A number of regional geologic formations occur beneath the major basin fill units within the Powder River Basin. These formations as shown on the regional stratigraphic column in Figure 3-1, are broadly present across Montana including the Powder River Basin. Penetrations of these formations by conventional oil and gas wells have been few in the Montana Powder River Basin and hydrocarbon production is scattered. The Cretaceous age Judith River, Shannon, Eagle, and Dakota/Lakota Formations are present in the subsurface between approximately 2,200 feet below ground surface (bgs) and 9,000 feet bgs. These four sandy formations are encased and overlain by thick Cretaceous shales of the Colorado and Pierre Formations (Noble et al, 1982). Reservoir quality sands are not present everywhere within each of these formations but each could locally be a suitable disposal zone for produced CBM water. In addition, the shales of the Colorado and Pierre Formations could perhaps accept produced water under injection pressures higher than fracture pressure. Only the Shannon Formation produces gas within the Powder River Basin. The Upper Cretaceous Eagle Formation contains coals in Blaine, Park, and Gallatin counties (Nobel et al. 1982). These coals are prospective for CBM resources but currently do not produce.

Upper Cretaceous Fox Hills and Hell Creek Formations

The Fox Hills Sandstone and Hell Creek Formations are Late Cretaceous in age and underlay the Fort Union in the Montana Portion of the Powder River Basin. The formations are difficult to separate in outcrop, and can be very difficult to separate in the subsurface, depending on the area, and appear to be in hydrologic continuity. Together, the Hell Creek and Fox Hills total approximately 500 feet of non-marine coastal plain sediments that have been shed from the mountains to the east and west (Perry, 1962). They are made up of variable, shaley sands that contain some of the youngest dinosaur fossils in the world. The sands are scattered over most of Eastern Montana but are not present everywhere in the Powder River Basin; the formations crop out at the edges of the basin and are found as deep as 3,700 feet bgs near the axis of the basin in Montana (Miller 1981). The Fox Hills Formation lies conformably upon approximately 2,000 feet of Upper Cretaceous Pierre Shale. The Hell Creek is overlain by the thick Tertiary Fort Union Formation.

Paleocene Fort Union Formation

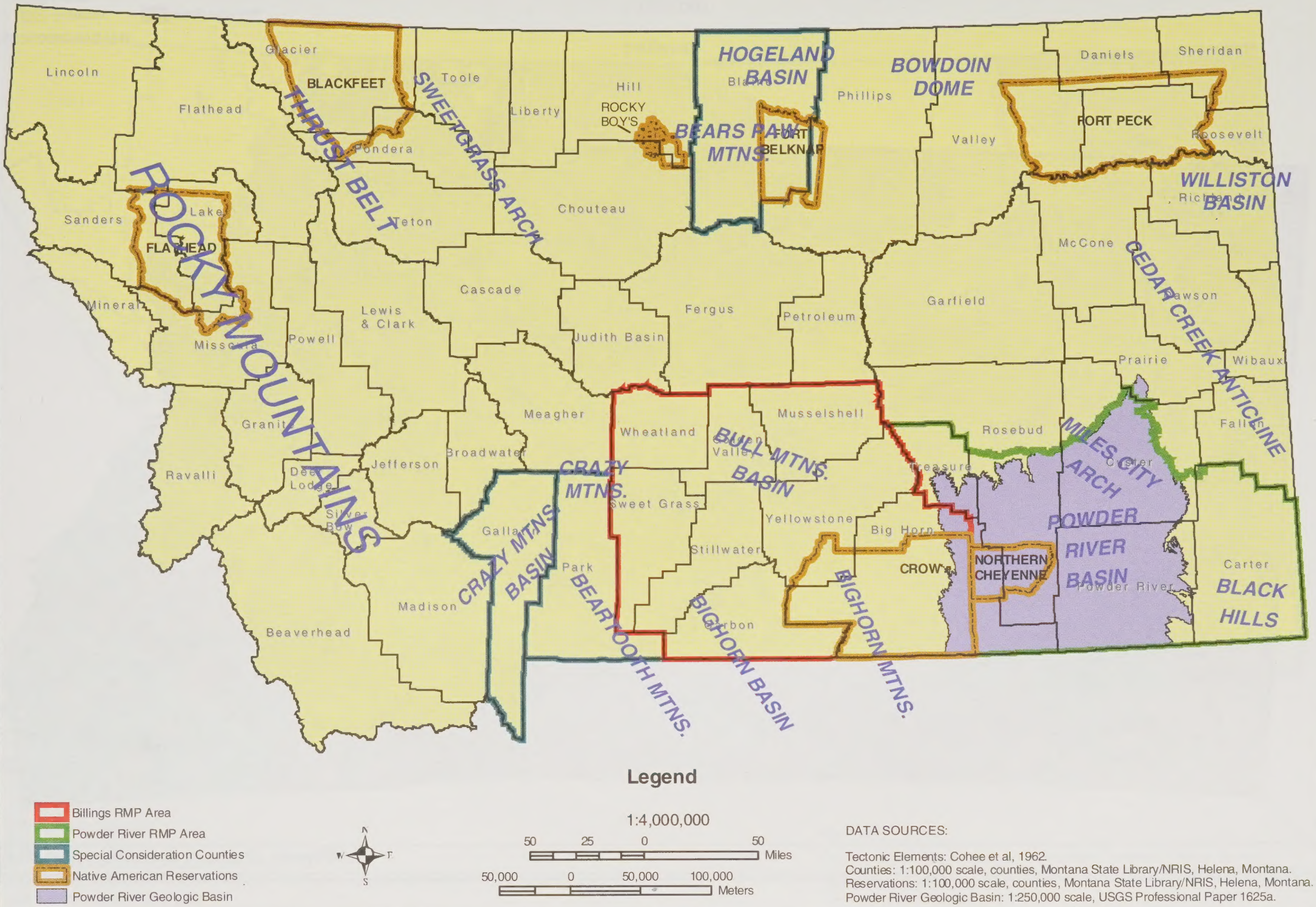
The Fort Union forms most of the sedimentary fill within the Montana Powder River Basin. It consists of approximately 3,500 feet of non-marine interbedded, sandstones, siltstones, shales and coal beds whose individual thicknesses can be as much as 37 feet near the Decker mine (Roberts et al, 1999a). The Fort Union also contains clinker deposits, formed by the natural burning of coal beds and the resultant baking or fusing of strata overlying the burning coal, which are present throughout much of the area and can be more than 125 feet thick (Tudor, 1975).

The Fort Union is split into three stratigraphic members: the lowest and oldest is the Tullock Member, overlain by the Lebo Shale Member, overlain by the Tongue River Member (McLellan et al. 1990). In the Montana portion of the Powder River Basin, the bulk of the coals are confined to the Tongue River Member, while the Lebo and Tullock Members are predominantly shale and shaley sand (McLellan et al. 1990). The Members are discussed in detail below:

The Tullock Member

This is the stratigraphically lowest part of the Fort Union, consisting of approximately 300 feet to more than 500 feet of interbedded sands and shales with minor coals near the base (Tudor 1975). The Tullock rests unconformably upon the Upper Cretaceous Hell Creek Formation throughout the Powder River Basin. While generally sandier, the Tullock is difficult to separate in outcrop and in the subsurface from the overlying Lebo Member.

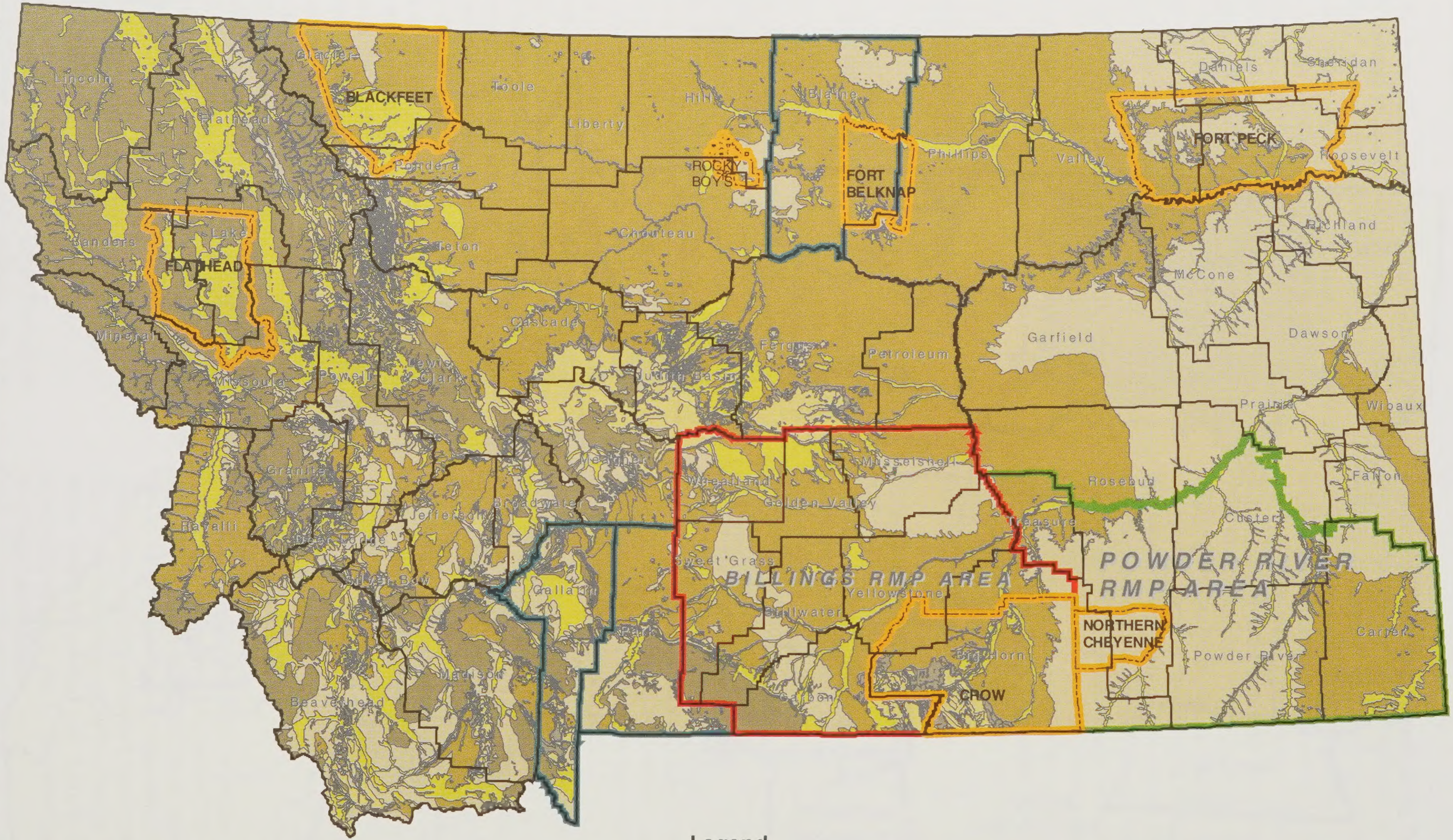
Map 3-1: Tectonic Element Map of the State of Montana


ROCKY MOUNTAINS
THRUST BELT
SWEETGRASS ARCH
HOGELAND BASIN
BOWDOIN DOME
BEARS PAW MTNS.
WILLISTON BASIN
CEDAR CREEK ANTICLINE
MILES CITY ARCH
POWDER RIVER BASIN
BLACK HILLS
BULL MTNS. BASIN
CRAZY MTNS.
CRAZY MTNS. BASIN
BEARTOOTH MTNS.
BIGHORN BASIN
BIGHORN MTNS.
BLACKFEET
ROCKY BOY'S
FORT BELKNAP
FORT PECK
FLATHEAD
CROW
NORTHERN CHEYENNE
Lincoln
Flathead
Glacier
Toole
Liberty
Hill
Blaine
Phillips
Valley
Daniels
Sheridan
Roosevelt
Richland
Pondera
Teton
Chouteau
Sanders
Lake
Mineral
Missoula
Powell
Lewis & Clark
Cascade
Judith Basin
Fergus
Petroleum
Garfield
McCone
Dawson
Prairie
Wibaux
Fallon
Granite
Ravalli
Deer Lodge
Silver Bow
Jefferson
Broadwater
Meagher
Wheatland
Golden Valley
Musselshell
Rosebud
Custer
Treasure
Yellowstone
Sweet Grass
Stillwater
Big Horn
Carter
Powder River
Gallatin
Park
Carbon
Madison
Beaverhead
Legend
Billings RMP Area
Powder River RMP Area
Special Consideration Counties
Native American Reservations
Powder River Geologic Basin
N
W
E
S
1:4,000,000
50
25
0
50
Miles
50,000
0
50,000
100,000
Meters

DATA SOURCES:

Tectonic Elements: Cohee et al, 1962.
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Powder River Geologic Basin: 1:250,000 scale, USGS Professional Paper 1625a.

Map 3-2: Statewide Outcrop Geology


Lincoln
Flathead
Glacier
BLACKFEET
Toole
Liberty
Hill
ROCKY BOY'S
Blaine
FORT BELKNAP
Phillips
Valley
Daniels
Sheridan
FORT PECK
Roosevelt
Pondera
Sanders
Lake
FLATHEAD
Teton
Chouteau
Richland
McCone
Mineral
Cascade
Fergus
Petroleum
Garfield
Dawson
Missoula
Powell
Lewis & Clark
Judith Basin
Prairie
Wibaux
Granite
Meagher
Wheatland
Musselshell
Golden Valley
Rosebud
Fallon
Ravalli
Deer Lodge
Jefferson
Broadwater
Treasure
Custer
Silver Bow
Sweet Grass
BILLINGS RMP AREA
Yellowstone
POWDER RIVER RMP AREA
Gallatin
Stillwater
Park
NORTHERN CHEYENNE
Carter
Big Horn
Powder River
Madison
Carbon
CROW
Beaverhead

GEOLOGIC SYSTEM

- ▨ Quaternary
- ▨ Tertiary
- ▨ Cretaceous
- ▨ Triassic
- ▨ Paleozoic
- ▨ Unknown

- ▭ Billings RMP Area
- ▭ Powder River RMP Area
- ▭ Special Consideration Counties
- ▭ Native American Reservations

N
W E
S

Legend

1:4,000,000

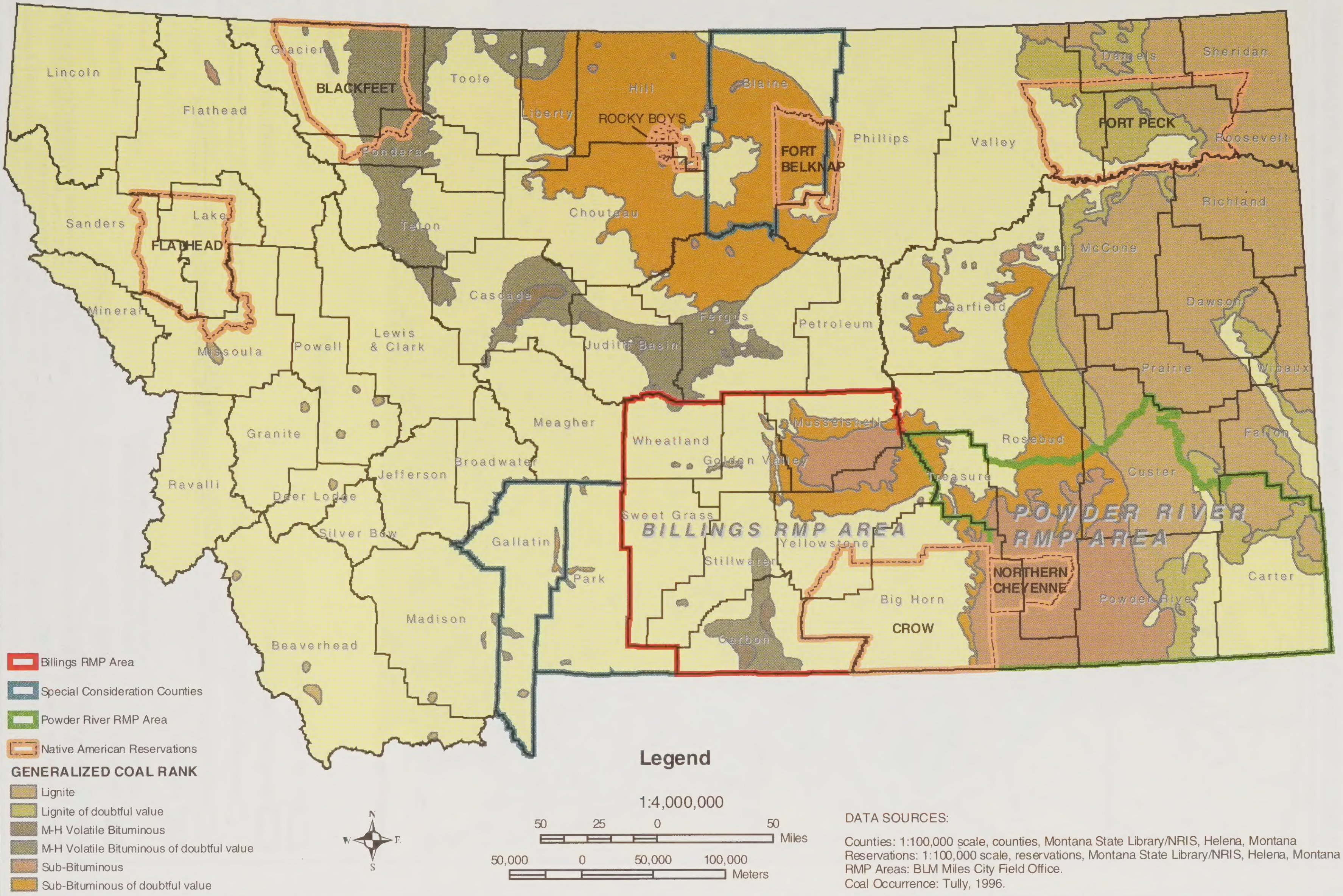
50 25 0 50 Miles

50,000 0 50,000 100,000 Meters

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana
Geology: 1:1,000,000 scale, geology, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office

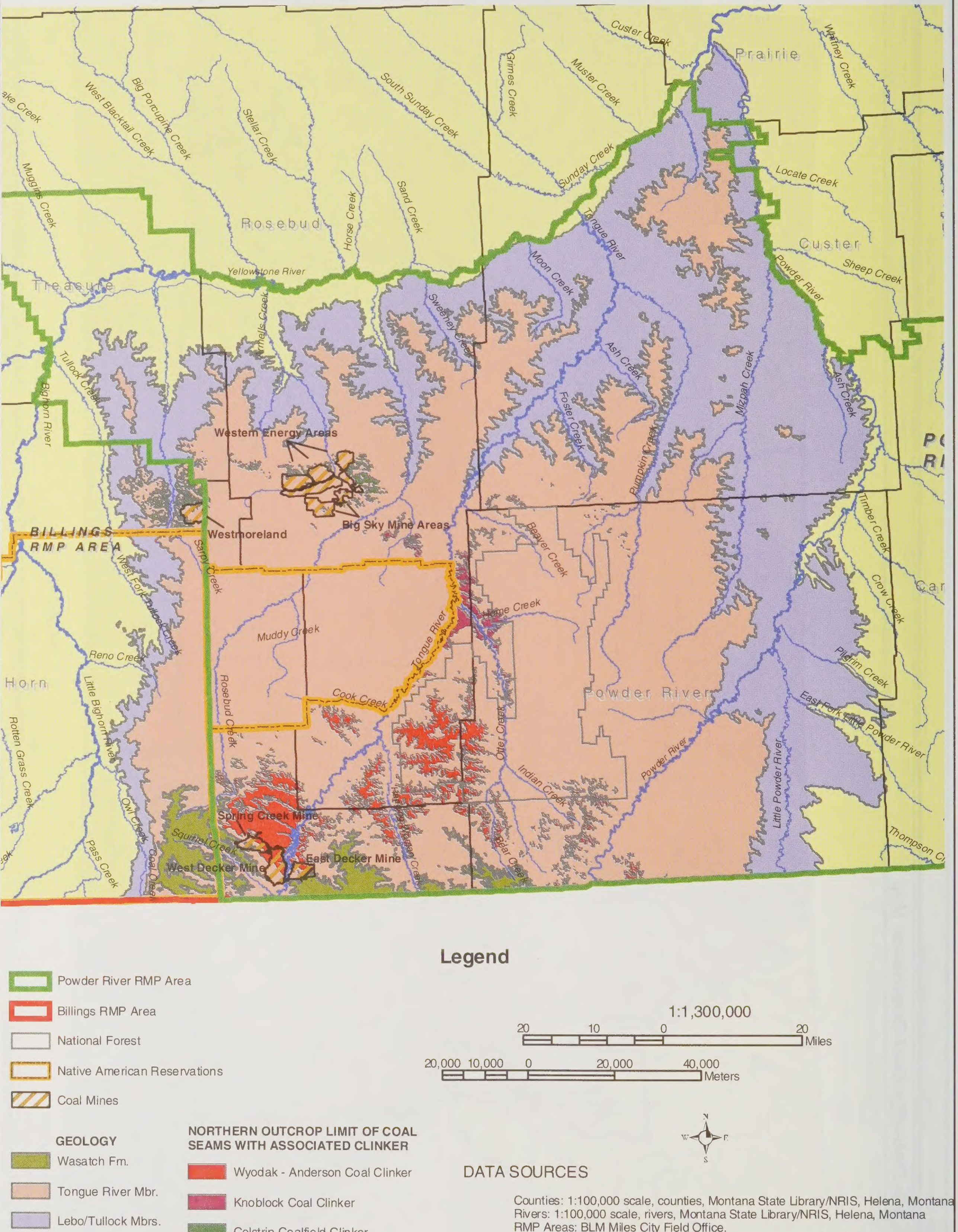
Map 3-3: Statewide Coal Occurrence Map


Lincoln
Flathead
Glacier
BLACKFEET
Toole
Liberty
Hill
ROCKY BOY'S
Blaine
FORT BELKNAP
Phillips
Valley
Daniels
Sheridan
FORT PECK
Roosevelt
Richland
Pondera
Sanders
Lake
FLATHEAD
Teton
Chouteau
McCone
Mineral
Missoula
Powell
Lewis & Clark
Cascade
Judith Basin
Fergus
Petroleum
Garfield
Dawson
Prairie
Wibaux
Granite
Meagher
Wheatland
Golden Valley
Musselshell
Rosebud
Custer
Fallon
Ravalli
Deer Lodge
Jefferson
Broadwater
Treasure
Silver Bow
Sweet Grass
BILLINGS RMP AREA
Yellowstone
POWDER RIVER RMP AREA
Gallatin
Park
Stillwater
NORTHERN CHEYENNE
Carter
Big Horn
Madison
CROW
Powder River
Carbon
Beaverhead
Billings RMP Area
Special Consideration Counties
Powder River RMP Area
Native American Reservations
GENERALIZED COAL RANK
Lignite
Lignite of doubtful value
M-H Volatile Bituminous
M-H Volatile Bituminous of doubtful value
Sub-Bituminous
Sub-Bituminous of doubtful value
N
E
S
W
Legend
1:4,000,000
50
25
0
50
Miles
50,000
0
50,000
100,000
Meters

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office.
Coal Occurrence: Tully, 1996.

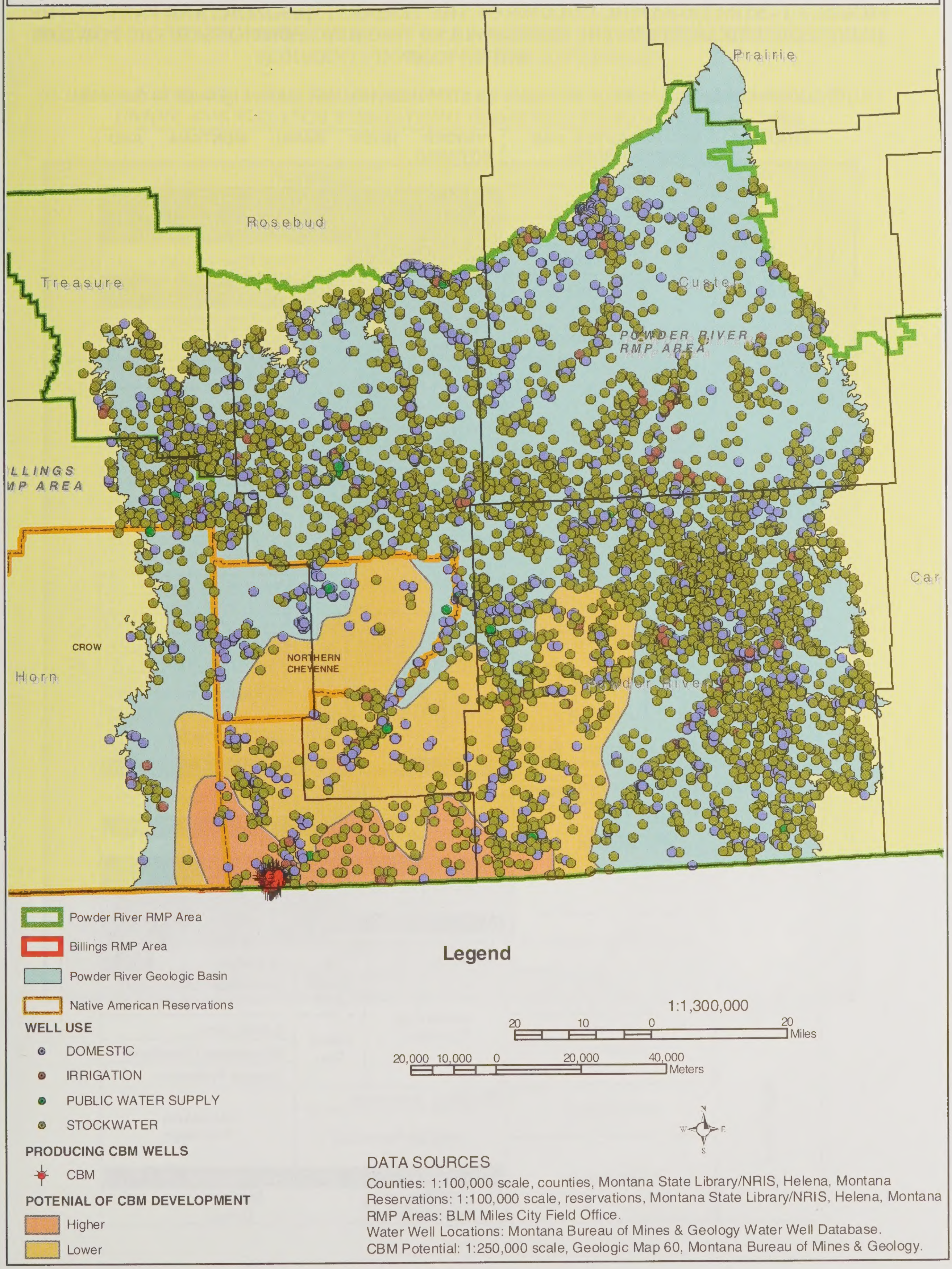
Map 3-4: Outcrop Geology and Clinker Deposits of the Montana Portion of Powder River Basin


Prairie
Rosebud
Treasure
Custer
Horn
Powder River
Custer Creek
Whitney Creek
Grimes Creek
Muster Creek
South Sunday Creek
Big Porcupine Creek
West Blacktail Creek
Stellar Creek
Muggins Creek
Sunday Creek
Locate Creek
Sand Creek
Horse Creek
Yellowstone River
Tongue River
Moon Creek
Sheep Creek
Powder River
Sweeney Creek
Armells Creek
Tullock Creek
Bighorn River
Ash Creek
Foster Creek
Mizpah Creek
Pumpkin Creek
Western Energy Areas
Big Sky Mine Areas
Westmoreland
BILLINGS RMP AREA
Sarpy Creek
West Fork Tullock Creek
Beaver Creek
Timber Creek
Crow Creek
Home Creek
Muddy Creek
Reno Creek
Little Bighorn River
Rosebud Creek
Cook Creek
Pilgrim Creek
East Fork Little Powder River
Rotten Grass Creek
Otter Creek
Indian Creek
Little Powder River
Spring Creek Mine
Squirrel Creek
Owl Creek
West Decker Mine
East Decker Mine
Hanging Woman Creek
Bear Creek
Pass Creek
Coal Creek
Thompson Cr
Legend
Powder River RMP Area
Billings RMP Area
National Forest
Native American Reservations
Coal Mines
GEOLOGY
Wasatch Fm.
Tongue River Mbr.
Lebo/Tullock Mbrs.
NORTHERN OUTCROP LIMIT OF COAL SEAMS WITH ASSOCIATED CLINKER
Wyodak - Anderson Coal Clinker
Knoblock Coal Clinker
Colstrip Coalfield Clinker
1:1,300,000
20 10 0 20 Miles
20,000 10,000 0 20,000 40,000 Meters
N
W
E
S

DATA SOURCES

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Rivers: 1:100,000 scale, rivers, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office.
Geology and Coal: 1:250,000 scale, 1999, USGS Professional Paper 1625a.
Coal Mine Boundaries: Montana Bureau of Mines & Geology

Map 3-5: Water Well Use, Current CBM Production, and CBM Likelihood in Powder River Basin


Prairie
Rosebud
Treasure
Custer
POWDER RIVER
RMP AREA
LLINGS
MP AREA
Car
CROW
Horn
NORTHERN
CHEYENNE
Powder River
Powder River RMP Area
Billings RMP Area
Powder River Geologic Basin
Native American Reservations
WELL USE
DOMESTIC
IRRIGATION
PUBLIC WATER SUPPLY
STOCKWATER
PRODUCING CBM WELLS
CBM
POTENIAL OF CBM DEVELOPMENT
Higher
Lower
Legend
1:1,300,000
20
10
0
20
Miles
20,000
10,000
0
20,000
40,000
Meters
N
W
E
S

DATA SOURCES

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office.
Water Well Locations: Montana Bureau of Mines & Geology Water Well Database.
CBM Potential: 1:250,000 scale, Geologic Map 60, Montana Bureau of Mines & Geology.

FIGURE 3-1 - STRATIGRAPHIC COLUMN OF THE TERIARY, MESOZOIC, AND PART OF THE PAELOZOIC SEDIMENTS IN THE MONTANA AND WYOMING PORTIONS OF THE POWDER RIVER BASIN

The column includes formations that make up CBM reservoirs and sources of water in the basin.

ERATHEM	SYSTEM, SERIES, AND OTHER DIVISIONS		POWDER RIVER BASIN, MONTANA AND WYOMING		
CENOZOIC	Quaternary		Alluvium		
	Tertiary	Pliocene	▨		▨
		Miocene	▨		▨
		Oligocene	▨		White River Formation
		Eocene	Wasatch Formation		▨
		Paleocene	Fort Union Formation		Tongue River Member
					Lebo Shale Member
					Tullock Member
MESOZOIC	Cretaceous	Upper	Hell Creek Formation		
			Fox Hills Sandstone		
			Lewis Shale		Pierre Shale
			Mesaverde Formation		
			Cody Shale		Niobrara Formation
					Carlile Shale
			Frontier Formation		Greenhorn Formation
					Belle Fourche Shale
			Mowry Shale		
		Lower	Muddy Sandstone		Newcastle Sandstone
			Thermopolis Shale		Skull Creek Shale
			Inyan Kara Group		Fall River Formation
					Lakota Formation
			▨		▨
	Jurassic		Morrison Formation		
			Sundance Formation		Upper Part
					▨
					Lower Part
			▨		▨
			Gypsum Spring Formation		▨
	Jurassic (?) or Triassic (?)		▨		▨
			Chugwater Group or Formation		Spearfish Formation (Upper part)
	Triassic		Goose Egg Formation	Upper part	
PALEOZOIC	Permian			Lower Part	(Lower part)
					Minnekahta Limestone
					Opeche Formation
	Pennsylvanian		Tensleep Sandstone		Minnelusa Formation
			Amsden Formation		
	Mississippian		▨		▨
			Madison Limestone		Madison Group

FIGURE 3-2 - STRATIGRAPHIC COLUMN OF UPPER CRETACEOUS AND LOWER TERTIARY SEDIMENTS IN THE POWDER RIVER BASIN

BEDROCK UNITS THAT FILL THE POWDER RIVER BASIN INCLUDE THE HELLCREEK, FORT UNION, AND WASATCH FORMATIONS (MODIFIED FROM RICE ET AL. 2000).

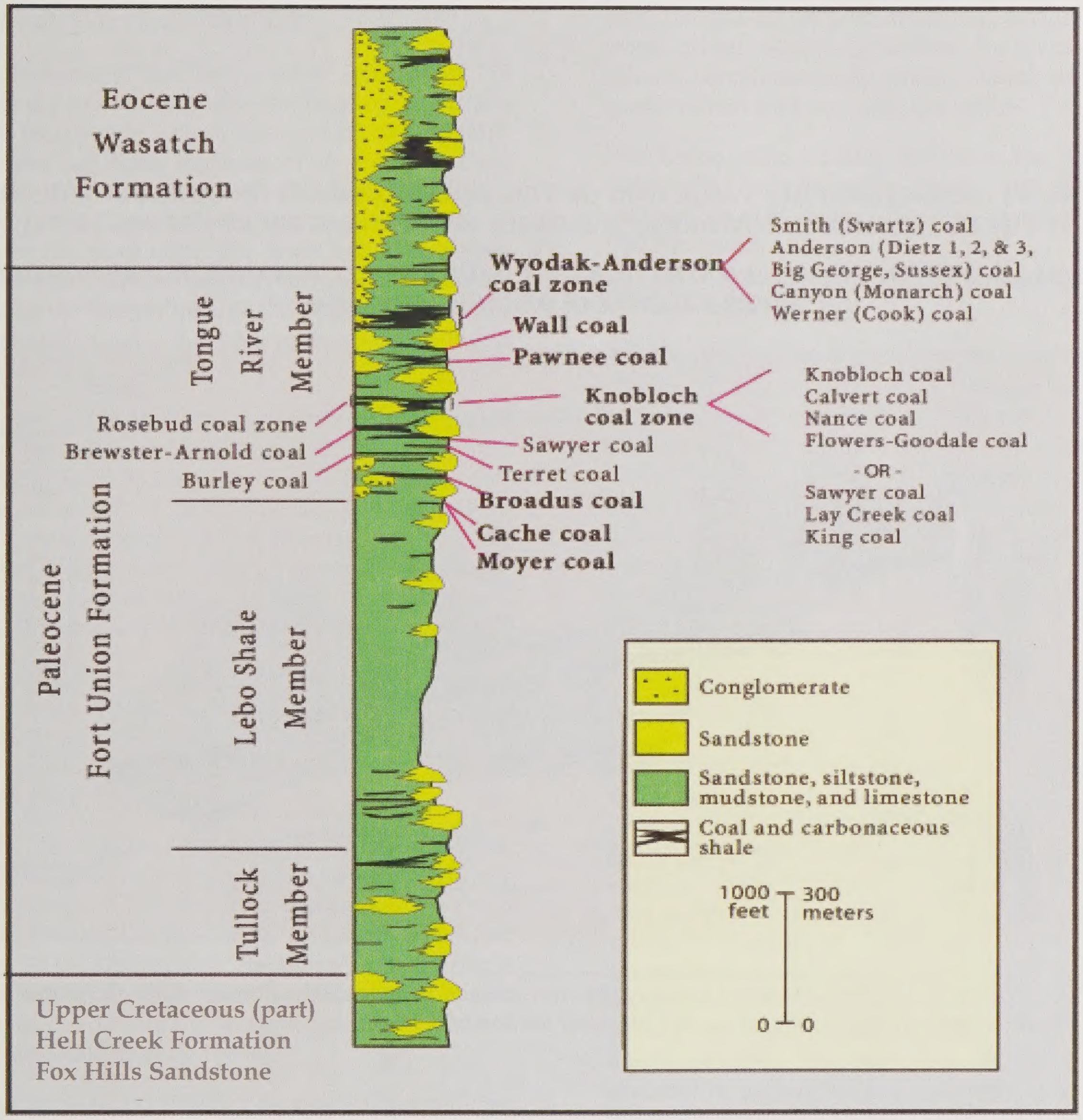
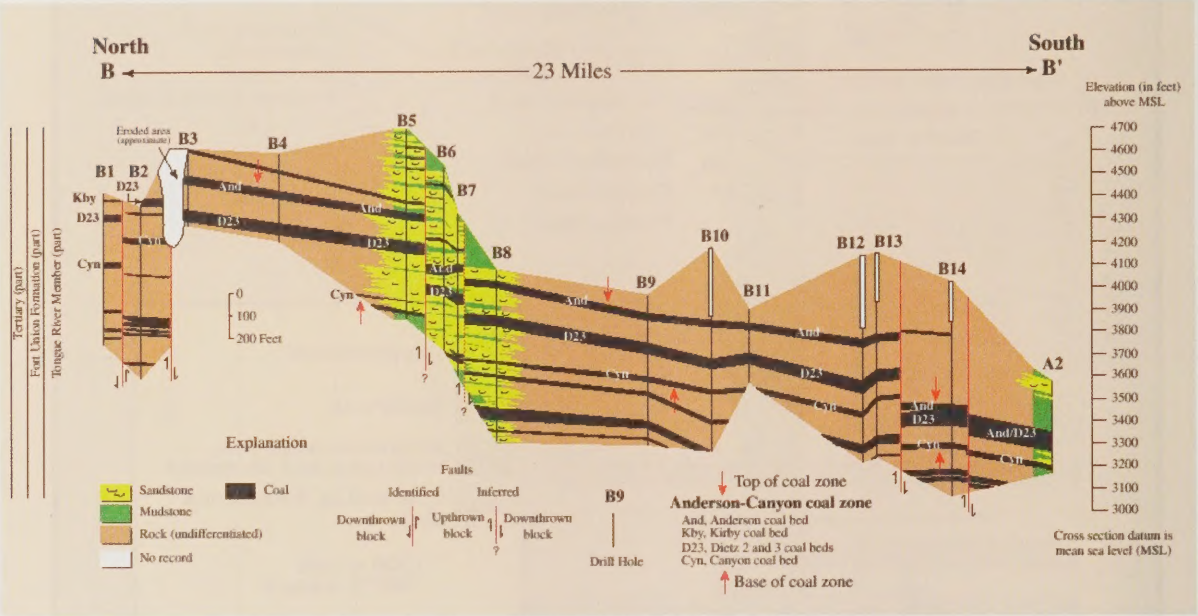

Eocene
Wasatch
Formation
Tongue River Member
Rosebud coal zone
Brewster-Arnold coal
Burley coal
Paleocene
Fort Union Formation
Lebo Shale Member
Tullock Member
Upper Cretaceous (part)
Hell Creek Formation
Fox Hills Sandstone
Wyodak-Anderson coal zone
Smith (Swartz) coal
Anderson (Dietz 1, 2, & 3, Big George, Sussex) coal
Canyon (Monarch) coal
Werner (Cook) coal
Wall coal
Pawnee coal
Knobloch coal zone
Knobloch coal
Calvert coal
Nance coal
Flowers-Goodale coal
- OR -
Sawyer coal
Lay Creek coal
King coal
Sawyer coal
Terret coal
Broadus coal
Cache coal
Moyer coal
Conglomerate
Sandstone
Sandstone, siltstone, mudstone, and limestone
Coal and carbonaceous shale
1000 feet
300 meters
0
0

FIGURE 3-3 - STRATIGRAPHIC VARIATION OF THE ANDERSON-CANYON COALS IN THE AREA OF THE DECKER MINE, POWDER RIVER BASIN, MONTANA (ROBERTS ET AL., 1999A)

CROSS-SECTION OF LOCALIZED STRATIGRAPHY OVER A SMALL PORTION OF THE POWDER RIVER BASIN NEAR DECKER, MONTANA.


North
B
23 Miles
South
B'
Elevation (in feet) above MSL
4700
4600
4500
4400
4300
4200
4100
4000
3900
3800
3700
3600
3500
3400
3300
3200
3100
3000
Tertiary (part)
Fort Union Formation (part)
Tongue River Member (part)
Eroded area (approximate)
B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
B11
B12
B13
B14
A2
Kby
D23
Cyn
And
And/D23
0
100
200 Feet
Explanation
Sandstone
Coal
Mudstone
Rock (undifferentiated)
No record
Faults
Identified
Inferred
Downthrown block
Upthrown block
Downthrown block
B9
Drill Hole
Top of coal zone
Anderson-Canyon coal zone
And, Anderson coal bed
Kby, Kirby coal bed
D23, Dietz 2 and 3 coal beds
Cyn, Canyon coal bed
Base of coal zone
Cross section datum is mean sea level (MSL)

Note: this cross-section reflects localized stratigraphy over a small portion of the Powder River Basin and is not intended to be a regional reflection of the entire Montana portion of the basin.

The Lebo Member

This middle member ranges from 75 feet to more than 200 feet of claystones, limestones, and mudstones with the Big Dirty coal (3 to 13 feet of thickness) at the very base (Tudor 1975).

The Tongue River Member

The thickness of the Tongue River varies from 750 feet at the outcrop edge near the fringe of the basin to 3,000 feet near the axis of the basin (Williams 2001). The total aggregate thickness of all the coal seams ranges up to approximately 150 feet (Ellis et al. 1999b). The Tongue River Member can be locally divided into three units. The lower unit includes that portion below the Sawyer coal seam. The Middle unit includes the Sawyer through the Wall coal seam. The Upper unit includes that portion above the Wall coal seam (Ellis et al. 1999b).

The Lower Tongue River unit is present across most of the Montana portion of the basin. It includes, from the base up, the Stag, Terret, Witham, Robinson, Rosebud-McKay, Flowers-Goodale, Nance, Calvert, and Knoblach coals. In the Ashland coalfield, the Lower Tongue River unit is up to 1,660 feet in thickness, and individual coals can be up to 71 feet thick (Roberts et al. 1999b).

The Middle Tongue River unit is present over a large part of the Montana portion of the Powder River Basin. It includes, from the base up, the Sawyer, Mackin -Walker, Cache, Odell, Brewster-Arnold, Pawnee, and Wall coals.

The Upper Tongue River unit is present only in the southern part of the Montana portion of the Powder River Basin. It includes, from the base up, the Otter, Cook, Carney, Canyon, Dietz, Anderson, and Smith coals. At the Decker mine, the Upper Tongue River is up to 1,500 feet thick; coals can attain an individual thickness of 57 feet and an aggregate thickness up to 111 feet (Roberts et al. 1999a).

Although coals are the most economically significant part of the Tongue River Member, they form a small portion of the sedimentary volume. They are also extremely variable stratigraphically, as shown in the cross-section depicted in Figure 3-3. Figure 3-3 shows stratigraphic variation of the Anderson-Canyon Coals in the area of the Decker Mine, Powder River Basin, Montana.

The cross-section illustrates the continuity or lack of continuity within the stratigraphic units. Coal aquifers can be seen to have local continuity but lack regional continuity. A local coal seam such as Dietz 1 can persist for several miles but the entire Anderson-Dietz package is eroded from the Colstrip area. The stratigraphic complications documented in Figure 3-2 suggest that even thinly separated coal seams may be very dissimilar. The cross-section illustrates the pinch-outs of coal seams, bifurcating coal seams, and erosional cut-off of coal seams by Paleocene and recent stream erosion. All of these factors can play a role in complicating the production of water and methane from the Fort Union Formation.

Fort Union coals are also present in the Big Horn Basin, the Bull Mountain Basin, and Park and Gallatin counties where they are prospective for CBM resources.

Wasatch Formation

The Eocene Age Wasatch is present in the Montana portion of the Powder River Basin as fine-to medium-grained sandstone lenses and channel-fill interbedded with silstones, shales, and minor coal. The thickness of the Wasatch Formation ranges from near zero at the outcrop edge to 400 feet near the southern state boundary (Roberts et al. 1999a). It is present in outcrop in the extreme southwest corner of the basin where it overlies the Fort Union.

Quaternary Alluvium

Quaternary age sediments are those that are Pleistocene (the latest glacial episode) and Recent (post-glacial episode) in age; the sequence is dominated by events and effects associated with continental glaciation, including glacial till and exaggerated peri-glacial valley fill. Quaternary sediments in the Powder River Basin and most of the state are present as variable fill in stream and river valleys. Quaternary Alluvium consists of unconsolidated sand, silt, and gravel that make up the floodplains and stream terraces of creek valleys in the Powder River Basin (BLM 1999b). Thickness is highly variable, but maximum thickness is not expected to exceed 90 feet. Lithology is somewhat dependent on bedrock outcrop; alluvium overlying the Tertiary strata are mostly fine-grained to medium-grained sands and silts. Coarser-grained alluvium may be associated with some of the larger rivers where provenance has been outside the Powder River Basin (Hodson et al. 1973). Alluvium aquifers are largely unconfined and connected to active river flow. Because alluvial aquifers can deliver large quantities of water to wells, they are important stratigraphic features. They are also important because they are vulnerable to impact and are often connected to surface water resources. Alluvial aquifers can be impacted by surface activity and can act as a conduit to carry those impacts to valuable surface water resources.

Powder River RMP Area

The Powder River RMP area is centered over the broad, flat-lying Powder River Basin, with basin margins rising up to the Black Hills (South Dakota) on the southeast and the Big Horn Mountains to the west. Oil production has occurred in The Powder River Basin since 1954. During 2000, eight conventional oil and natural gas fields were active in the RMP area (MBOGC 2001a). Production trends summarized in Figure MIN-1 of the Minerals Appendix (ALL 2001b) shows a sharp decline of oil production during the past 15 years caused by the aging of the several Muddy Formation fields on the edge of the basin. During the same time, conventional natural gas production from shallow Cretaceous reservoirs has increased, although it has remained at minor levels.

Billings RMP Area

The Billings RMP area centers on the Montana portion of the Big Horn Basin, the largest structural element in the area. The RMP area also includes the Big and Little Snowy and Little Belt Mountains to the north that combine to make up the Central Montana Uplift. Oil and gas is produced from the Big Horn Basin and oil is also produced from the Central Montana Uplift. Natural gas and oil were produced from 68 fields in the year 2000. Production statistics for 2000 show a 50 percent decline of both natural gas and oil production in the past 15 years, although significant quantities of both commodities are still being produced in the area (ALL 2001b).

Conventional Oil and Gas

Conventional oil and gas resources are scattered across Tertiary and older basins of the state, as well as in faulted and thrusted sedimentary rocks at the edges of some of the basins. The type of hydrocarbon fluids that are produced (oil, natural gas, or both) varies with the local geology and position in the field. Natural gas can be produced along with oil in some reservoirs or it can be produced “dry”—without associated oil. Most oil and gas reservoirs will also produce associated water. Produced water is mostly reinjected into the producing formations to maintain reservoir energy or into non-productive, salt-water bearing reservoirs although there are currently 24 surface water discharge permits that have been issued for producing conventional oil and gas fields.

- The Williston Basin produces the majority of the oil for the State of Montana and small amounts of natural gas associated with the oil; except for shallow gas fields along the Cedar Creek Anticline, little dry gas is produced.
- North-central Montana produces mainly dry natural gas from shallow fields.
- Northwestern Montana produces shallow oil with little associated natural gas.
- Central Montana produces oil with virtually no natural gas.
- The Big Horn Basin produces small amounts of both oil and natural gas.
- The Powder River Basin produces small amounts of oil at the eastern edge of the basin and very small amounts of conventional natural gas from shallow reservoirs (MBOGC 2000).

Conventional oil and gas production for the RMP areas is summarized in the Minerals Appendix of this volume.

Coal Bed Methane

CBM is a naturally occurring resource becoming very important throughout the U.S. CBM is natural gas that is generated during the geological process of converting plant material into coal through the action of burial and geothermal temperatures. Several thousand CBM wells have been completed in the Wyoming portion of the Powder River Basin while only approximately 300 CBM wells exist in the Montana portion. CBM is discussed in more detail in the Minerals Appendix of this volume and in the Water Resources Technical report (ALL 2001b) that includes numerous important references.

Coal

Coal occurs in all of the RMP areas discussed in this EIS. Coal mining has also historically occurred in Park and Gallatin counties (Roberts 1966, and Calvert 1912a and 1912b). Coal mining is underway at five mines in the Powder River RMP area, but has historically been accomplished in the Billings RMP area and Blaine County (USDL 1999). A more detailed description is included in the *Final Environmental Impact Statement, Resource Management Plan, Powder River Resource Area* (BLM 1984b). Coal resources are discussed in more detail in the Minerals Appendix of this volume.

Mineral Materials

Construction materials that are classified as saleable minerals are found in the RMP areas. These include sand and gravel, scoria, common clay, and crushed common stone not subject to regulation under the 1872 Mining Law. Descriptions of these materials are given under Mineral Materials and Locatable Minerals in the *Final Oil and Gas RMP/EIS Amendment* (BLM 1992) and in the *Final Environmental Impact Statement, Resource Management Plan, Billings Resource Area* (BLM 1983) as well as the Final EIS Amendment for the Billings, Powder River, and South Dakota Resource Management Plans of the Miles City District (BLM 1992).

Locatable Minerals

Locatable minerals are subject to provisions of the 1872 Mining Law. Minerals such as vanadium, uranium, gold, silver, gypsum, and uncommon varieties of bentonite are found in the various planning areas. Detailed descriptions of management practices for locatable minerals on federally managed lands are given in the *Final RMP/EIS* for the Billings and Powder River Resource Management Plans of the Miles City District (BLM 1983, 1984b).

Hydrological Resources

Hydrology within the planning area consists of surface water flow from several rivers and their associated tributaries, and the production of groundwater from a variety of geological formations—the combination of which comprises the aquifer systems within any specific portion of the planning area. Of particular importance to residents is the protection of surface water and groundwater in the vicinity of CBM development. CBM development typically involves the necessary and unavoidable production of large volumes of water from coal aquifers and the appropriate use or disposal of this produced water. Continuous CBM water production and disposal has the ability to impact both groundwater and surface water. As such, it is the subject of the Montana Department of Natural Resources and Conservation (DNRC) Final Order: In the Matter of the Designation of the Powder River Basin Controlled Groundwater Area. This order describes the authorities that pertain to CBM development. A copy of the order is included as an appendix to the Water Resources Technical Report (ALL 2001b). The order outlines water rights issues, mitigation, monitoring plans, and jurisdiction. Jurisdiction is summed up by this paragraph of the Order:

> "With this designation of a controlled groundwater area the withdrawal of groundwater associated with coal bed methane production will be under the prior jurisdiction of the Montana Board of Oil and Gas. However, water rights matters and hydrogeologic issues are not within the ordinary technical expertise and area of concern to the Board. These are matters ordinarily dealt with by the Montana Department of Natural Resources and Conservation and the Montana Bureau of Mines and Geology.
>
> The Montana Department of Natural Resources may petition the Board for hearings in regard to the production, use, and disposal of water from coal bed methane development wells that could effect existing water rights in the area based upon information gathered concerning water withdrawals."

Protection of groundwater will focus on maintaining beneficial uses. The coal seams are the primary aquifers for the agricultural community in southeastern Montana. In many areas, the coal aquifers supply water for livestock, wildlife, and domestic use. In the Bull Mountain coalfield, the coal seams are also used as aquifers, though to a lesser degree than in southeastern Montana. In other coal bearing areas of the State, coal seams are not used as aquifers, or that use is limited and not well documented.

Surface Water

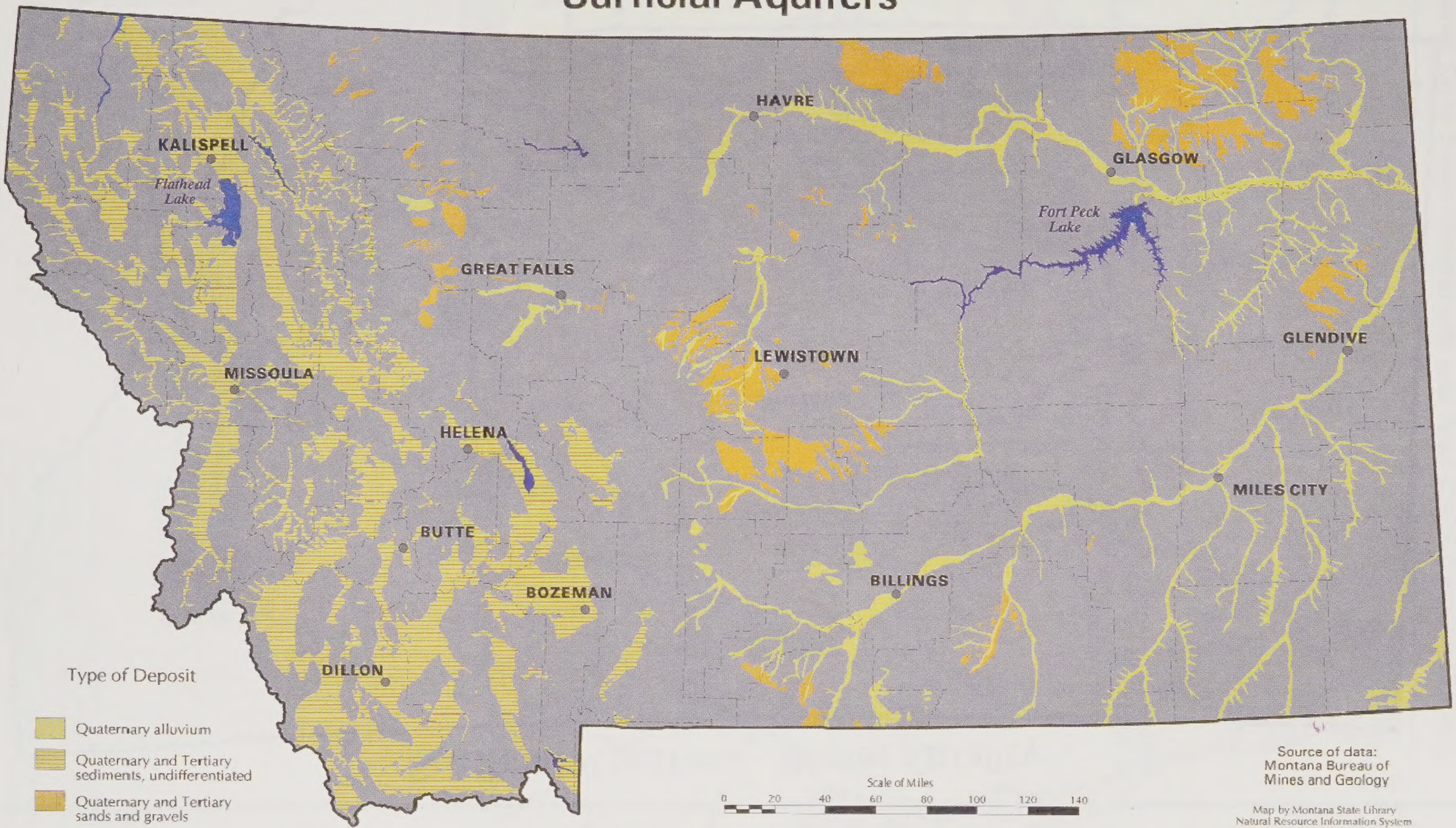
Surface water is the primary source of water for all uses in Montana, representing 97 percent of the water used throughout the State (Solley et al. 1995). The quality of groundwater from near-surface aquifers within the west half of the Billings RMP area, as well as in Park and Gallatin counties, is usually very good. Maps 3-6 and 3-7 show the occurrence of surficial aquifers as well as the quality of the groundwater produced from these aquifers.

Map 3-8 shows that portion of the planning area with the greatest potential for CBM development. The map outlines those areas of continuous surface drainage termed watersheds; each watershed is drained by a single main stream element. The map emphasizes those watersheds vulnerable to impact from CBM water. The volume and quality of surface water can best be interpreted on a watershed basis. Table 3-4 lists basic data on volume and quality for the USGS stations used in the analysis of impacts to surface water in the SWQTR. This information is also summarized in Chapter 4 of this EIS and is depicted on Map 3-8.

Generally, water quality at a particular station varies inversely with flow volume. High-flow periods (Maximum Mean Monthly Flows) correspond to the seasonal influx of relatively low salinity, low SAR, meteoric waters, during spring snowmelt and early summer rains. Low-flow periods (Minimum Mean Monthly Flows) correspond to periods of scarce surface water, typically during the winter when streams are fed only by the influx of more saline, higher SAR groundwaters. Thus, high flows correspond to times of high water quality and low flows correspond to times of low surface water quality. The Tongue River near Decker illustrates this variation with a discharge rate as seen in Figure 3-4.

Map 3-6

Surficial Aquifers

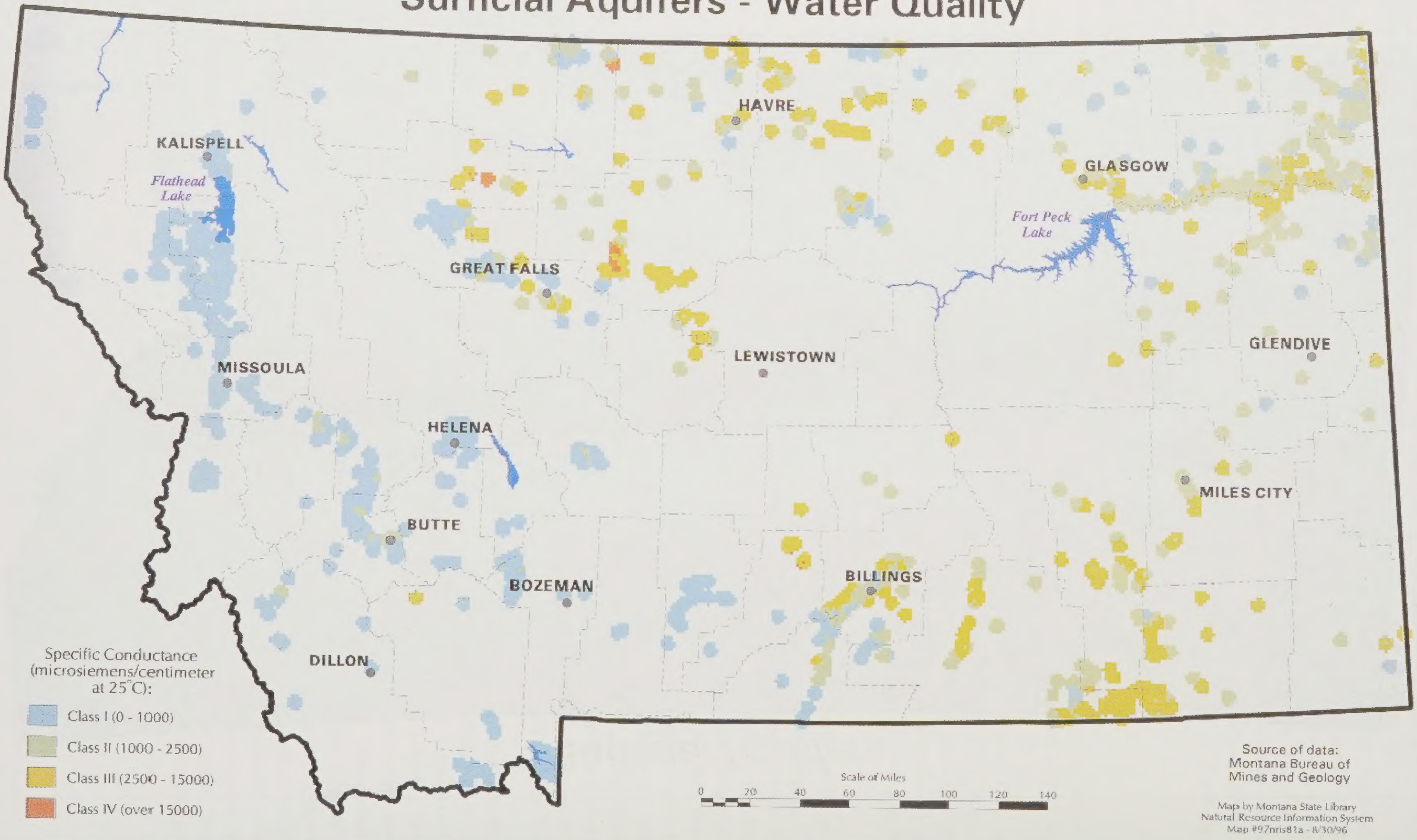

KALISPELL
Flathead Lake
HAVRE
GLASGOW
Fort Peck Lake
GREAT FALLS
LEWISTOWN
GLENDIVE
MISSOULA
HELENA
MILES CITY
BUTTE
BILLINGS
BOZEMAN
DILLON
Type of Deposit
Quaternary alluvium
Quaternary and Tertiary sediments, undifferentiated
Quaternary and Tertiary sands and gravels
Scale of Miles
0
20
40
60
80
100
120
140

Source of data:
Montana Bureau of
Mines and Geology

Map by Montana State Library
Natural Resource Information System
Map #97nris81d - 8/30/96

Map 3-7

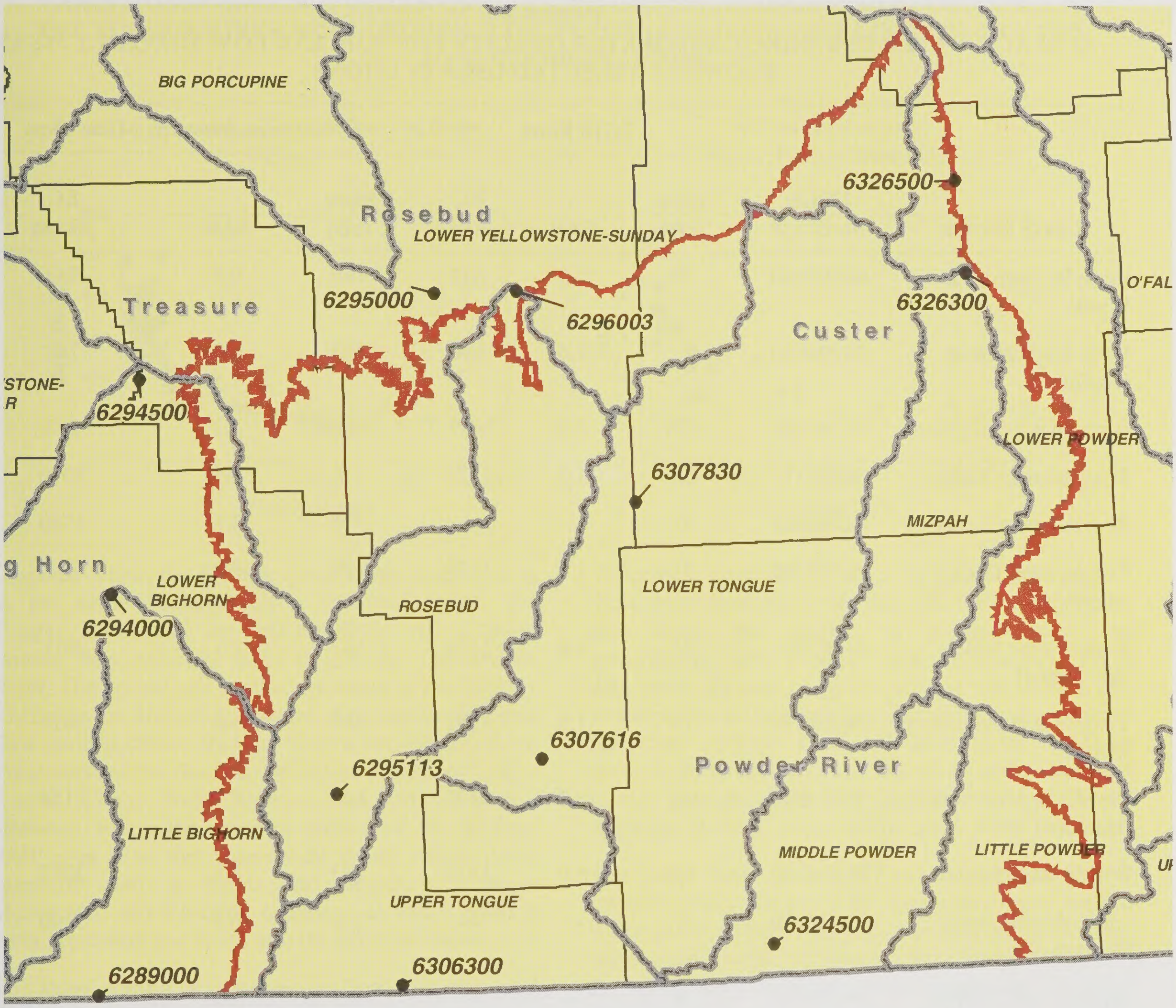
Surficial Aquifers - Water Quality


HAVRE
KALISPELL
Flathead Lake
GLASGOW
Fort Peck Lake
GREAT FALLS
GLENDIVE
LEWISTOWN
MISSOULA
HELENA
MILES CITY
BUTTE
BILLINGS
BOZEMAN
DILLON
Specific Conductance (microsiemens/centimeter at 25°C):
Class I (0 - 1000)
Class II (1000 - 2500)
Class III (2500 - 15000)
Class IV (over 15000)
Scale of Miles
0
20
40
60
80
100
120
140

Source of data:
Montana Bureau of
Mines and Geology

Map by Montana State Library
Natural Resource Information System
Map #97nris81a - 8/30/96

Map 3-8: Powder River Basin Watersheds and Area USGS Gauging Stations.


BIG PORCUPINE
Rosebud
LOWER YELLOWSTONE-SUNDAY
Treasure
6295000
6296003
6326500
6326300
O'FAL
Custer
STONE-
R
6294500
LOWER POWDER
6307830
MIZPAH
g Horn
LOWER
BIGHORN
6294000
ROSEBUD
LOWER TONGUE
6307616
6295113
Powder River
LITTLE BIGHORN
MIDDLE POWDER
LITTLE POWDER
UP
UPPER TONGUE
6324500
6306300
6289000

Legend

1:1,400,000

0 3.5 7 14 21 28 Miles

0 14,000 28,000 56,000 Meters

● USGS Gauging Stations

▭ Watershed Boundaries

🟥 Powder River Geologic Basin Bnd.

N
W E
S

DATA SOURCES:
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, MT.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, MT.
National Forests: 1:100,000 scale, national forests, Montana State Library/NRIS, Helena, MT.
Parks: 1:100,000 scale, parks, Montana State Library/NRIS, Helena, MT
Development Data: BLM Reasonable Foreseeable Development Scenario
Coal Occurence: Tully, 1996.

NOTE: To be used as a reference graphic only. Some data represented are at scales greater than it's source.

TABLE 3-4
SURFACE WATER DISCHARGE AND WATER QUALITY FOR 7Q10 AND LOW MONTHLY MEAN FLOWS AT SELECTED USGS STATIONS

		7Q10 Flow			Minimum Monthly Mean Flow		
USGS Station	**USGS Station #**	**Flow (cfs)**	**SAR**	**EC µS/cm**	**Flow (cfs)**	**SAR**	**EC µS/cm**
Little Bighorn near Wyola	06289000	47	0.8	629	110	0.5	548
Little Bighorn near Hardin	06294000	21	1.6	830	123	1.0	768
Bighorn near Bighorn	06294500	870	2.8	989	1523	2.1	952
Rosebud near Kirby	06295113	0.1	1.2	1123	1.8	0.8	1016
Rosebud near Rosebud	06296003	0	---	---	8.4	4.8	1780
Tongue near Decker (stateline)	06306300	43	1.3	1179	178	0.9	731
Tongue near Birney Day School	06307616	45	1.6	1159	183	1.1	863
Tongue at Brandenburg Bridge	06307830	70	1.8	1281	207	1.4	1016
Powder at Moorhead (stateline)	06324500	0.1	6.2	4400	145	4.7	2154
Powder near Locate	06326500	1.6	6.9	3313	143	4.6	2287
Little Powder near Weston, WY	06324970	0	---	---	3.0	6.9	3300
Mizpah near Mizpah	06326300	0	---	---	0.3	16.6	3503
Yellowstone at Forsyth	06295000	2855	1.84	831	5820	2.0	745
Yellowstone near Sidney	06329500	2240	2.5	809	5764	2.0	870

7Q10 Flow = The lowest flow that would be statistically expected to occur for 7 consecutive days during any 10 year period, based on historical data.

Minimum Mean Monthly Flow = The lowest mean monthly flow for the station based on historical data.

EC = Electrical Conductance

SAR = Sodium Adsorption Ratio

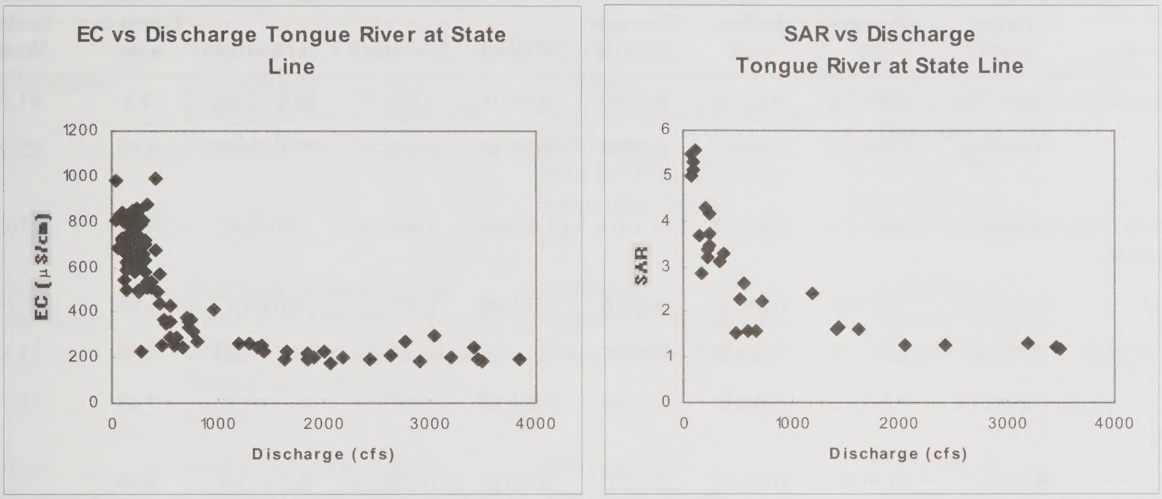
cfs = cubic feet per second

µS/cm = microseimens per centimeter

--- indicates that this value is not applicable

All water quality values shown have been determined from historical data obtained from the USGS for the flow volume in question.

FIGURE 3-4
VARIATION IN SURFACE WATER QUALITY WITH FLOW AT USGS STATION 06306300 ON THE TONGUE RIVER NEAR DECKER, BASED UPON USGS DATA FROM OCTOBER 16, 1985 TO SEPTEMBER 12, 2000



Drainage within the Powder River Basin study area is to the Little Bighorn River, Rosebud Creek, the Tongue River, and the Powder River. All of these streams flow generally north to join the Yellowstone River. The central and southern portions of the Billings RMP area are drained by a series of tributaries that also flow north-northeast into the Yellowstone River; these tributaries are the Boulder, Stillwater, Rock/Red Lodge Creeks, Clarks Fork, Bighorn, and Little Bighorn. Drainage within the northern portion of the Billings RMP area is to the Musselshell River, which flows eastward until it meets the boundary between Musselshell and Rosebud counties—at which point it turns northward and flows into the Missouri River.

The three additional counties of Park, Gallatin, and Blaine each have separate watersheds. Park County is drained by the Yellowstone River, which flows to the northeast. Much of the drainage in Gallatin County is to the Gallatin River, which flows northerly to the Missouri River. However, the eastern portion of Gallatin County is drained by streams that flow into the Yellowstone River. Blaine County is drained by the Milk River, which flows to the east and into the Missouri River.

Surface water can be impacted by cultural activity such as agriculture and industry. When groundcover is broken it exposes soil to wind and water erosion, leading to suspended sediment being brought to bodies of surface water. Artificial impoundments can cause infiltration into the soil and migration into surface water. Accidental releases of wastes can migrate into water bodies.

Watershed water-use statistics in Table 3-5 apply to those watersheds shown in Map 3-8. Table 3-5 presents data about the quantity of surface water and groundwater used in each water-use category. These data cover the area projected to have maximum CBM potential but similar data is available for other areas of the state (USGS 1995). Surface water in these watersheds is the dominate source of water, however locally groundwater use is important for public and domestic drinking water, and for stock water.

The Clean Water Act of 1972 and amendments require states to adopt standards for the protection of surface water quality. These standards are designed to maintain water quality sufficient to support the beneficial uses of the water body. Montana water bodies are classified according to the present and future beneficial uses that they normally would be capable of supporting (75-5-301 MCA). The state Water-Use Classification System (ARM 17.30.621-629) identifies the following beneficial uses:

- Drinking, culinary use, and food processing
- Aquatic life support for fishes and associated aquatic life, waterfowl, and furbearers
- Bathing, swimming, recreation, and aesthetics
- Agriculture (crop irrigation, stock watering, etc.) water supply
- Industrial (coal mining, electrical power generation, etc.) water supply

TABLE 3-5
WATER USE (IN MILLIONS OF GALLONS PER DAY [gpd]) STATISTICS IN 1995 BY WATERSHED SURFACE AND/OR GROUNDWATER USE

Watershed	Public Supply	Domestic	Industrial	Thermo-Electric	Mining	Livestock	Irrigation	Total Groundwater	Total Surface Water
Little Bighorn	0.01/0.15	0.0/0.12	0.0/0.0	0.0/0.0	0.0/0.0	0.9/0.37	84.01/1.46	2.1	84.24
Lower Bighorn	0.61/0.02	0.0/0.25	0.0/0.01	0.0/0.0	0.0/0.44	0.3/0.73	221.6/3.67	5.12	222.51
Lower Yellowstone	2.37/0.19	0.0/0.17	0.0/0.12	16.1/0.0	0.45/0.0	1.48/0.4	250/2.56	3.44	270.4
Rosebud	0.01/0.43	0.0/0.08	0.0/0.0	0.0/0.0	0.0/1.04	0.2/0.25	8.04/0.1	1.90	8.25
Upper Tongue	0.0/0.06	0.0/0.09	0.0/0.0	0.0/0.0	0.0/0.0	0.11/0.27	23.75/0.34	0.76	23.86
Lower Tongue	0.01/0.11	0.0/0.17	0.0/0.0	0.0/0.0	0.0/1.18	0.45/0.61	36.29/0.36	2.43	39.75
Middle Powder	0.01/0.12	0.0/0.04	0.0/0.0	0.0/0.0	0.0/0.0	0.02/0.24	3.18/0.04	0.44	3.21
Mizpah	0.0/0.0	0.0/0.03	0.0/0.0	0.0/0.0	0.0/0.0	0.1/0.19	6.41/0.06	0.28	6.51
Little Powder	0.0/0.12	0.0/0.04	0.0/0.0	0.0/0.0	0.0/0.0	0.05/0.24	2.18/0.03	0.43	2.23
Lower Powder	0.0/0.0	0.0/0.06	0.0/0.0	0.0/0.0	0.0/0.0	0.5/0.24	9.65/0.09	0.39	10.15

Source: USGS 1995

The current use classification of each water body in Montana was assigned on the basis of its actual or anticipated uses in the early 1970s. Water bodies are classified primarily by: 1) the level of protection that they require; 2) the type of fisheries that they support (warm water or cold water) or; 3) their natural ability to support use for drinking water, agriculture, etc. The water quality standards employed to maintain these uses address changes from natural conditions for such parameters as coliform bacteria, dissolved oxygen, pH, turbidity, temperature, color, toxics, and other harmful substances.

When streams and other water bodies are impacted by outside agents, their support of beneficial uses can become impaired. In Montana, surface water quality is tracked by the MDEQ. Table 3-6 is a compilation of impaired and threatened water bodies in need of water quality restoration. Water bodies included in this list do not currently support their original beneficial uses. This list is commonly referred to as the “303(d) List” because it is prepared in accordance with the requirements of Section 303(d) of the Federal Clean Water Act.

Several of the above watersheds and impaired water bodies are shared jurisdictionally between the State and Tribes. Segment MT42C001, the Tongue River from the reservoir to the mouth, for instance is shared between the State of Montana and the Northern Cheyenne Tribe, with the boundary lying in the middle of the river. The Lower Tongue Watershed intersects with the Northern Cheyenne Reservation. The Rosebud watershed includes most of the Northern Cheyenne Reservation and a part of the Crow Reservation; the Northern Cheyenne Reservation contacts the impaired portion of the Rosebud Creek. The Lower Bighorn watershed includes a large part of the Crow Reservation, which contacts both impaired portions of the Bighorn River. The Little Bighorn watershed includes a large part of the Crow Reservation but no water bodies are determined to be impaired on the 1996 list.

TABLE 3-6
IMPAIRED WATER BODIES IN AREA OF MAXIMUM CBM POTENTIAL

Watershed	Impaired Water body	Probable Causes of Impairment	Probable Sources of Impairment
Lower Yellowstone	Yellowstone River (MT42K001-1) from the Forsyth to the mouth of the Powder River	Metals Nutrients Other Habitat Alterations Pathogens Salinity/TDS/Chlorides Suspended Solids pH	Agriculture Irrigated Crop Production Municipal Point Sources Natural Sources Range Land Streambank Modification/Destabilization
Lower Yellowstone	East Fork of the Armells Creek (MT42KJ002-3) from Colstrip to the mouth of the West Fork of the Armells Creek	Nutrients Salinity/TDS/Chlorides Suspended Solids	Agriculture Natural Sources Range Land
Lower Yellowstone	East Fork of the Armells Creek (MT42KJ002-9) above Colstrip	Nutrients Suspended Solids	Agriculture Range Land
Lower Yellowstone	West Fork of the Armells Creek (MT42KJ002-4)	Flow Alteration Nutrients Salinity/TDS/Chlorides Suspended Solids	Agriculture Natural Sources Range Land
Lower Yellowstone	East Fork of the Sarpy Creek (MT42KJ002-2)	Salinity/TDS/Chlorides Suspended Solids	Natural Sources Resource Extraction Silviculture Surface Mining
Little Bighorn	None		
Lower Bighorn	Bighorn River (MT43P003-1) Excludes Tribal reservation Waters	Metals Salinity/TDS/Chlorides Suspended Solids Thermal Modifications pH Other Inorganics Siltation	Agriculture Flow Regulation/Modification Natural Sources Upstream Impoundments
	Bighorn River (MT43P005-1)	Metals Salinity/TDS/Chlorides Suspended Solids Thermal Modifications pH Flow Alteration Nutrients Other Inorganics	Agriculture Flow Regulation/Modification Natural Sources Upstream Impoundments
Lower Big Horn	Tullock Creek (MT43P006-1)	Metals Salinity/TDS/Chlorides Suspended Solids Nutrients	Agriculture Irrigated Crop Production Natural Sources

TABLE 3-6
IMPAIRED WATER BODIES IN AREA OF MAXIMUM CBM POTENTIAL

Watershed	Impaired Water body	Probable Causes of Impairment	Probable Sources of Impairment
		Other Inorganics	
Upper Tongue	Hanging Woman Creek (MT43B002)	Flow Alteration Metals Salinity/TDS/Chlorides	Agriculture Irrigated Crop Production Natural Sources
Upper Tongue	Hanging Woman Creek from Stroud Creek to the mouth	Siltation	Grazing and Agriculture
Upper Tongue	Tongue River Reservoir	Nutrients Organic Enrichment/DO Suspended Solids	Agriculture Municipal Point Sources
Upper Tongue	Upper Tongue River (MT43B001-1) above reservoir	Flow Alteration	Agriculture Irrigated Crop Production Natural Sources
Upper Tongue	Tongue River (MT43B001-2) from the Reservoir to mouth of Hanging Woman Creek	Flow Alteration	Agriculture Flow Regulation/Modification Irrigated Crop Production
Lower Tongue	Tongue River (MT42C001) from reservoir to the mouth	Flow Alteration Metals Other Organics Salinity/TDS/Chlorides Suspended Solids	Agriculture Flow Regulation/Modification Irrigated Crop Production Natural Sources
Lower Tongue	Otter Creek (MT42C002-2)	Metals Other Habitat Alterations Salinity/TDS/Chlorides Suspended Solids	Agriculture Highway/Road/Bridge Construction Land Development Natural Sources
Lower Tongue	Pumpkin Creek (MT43C002-6)	Flow Alteration Salinity/TDS/Chlorides Thermal Modifications	Agriculture Irrigated Crop Production
Rosebud	Rosebud Creek (MT42A001)	Flow Alteration Metals Nutrients Other Organics Salinity/TDS/Chlorides Suspended Solids	Agriculture Irrigated Crop Production Natural Sources
Mizpah	Mizpah Creek (MT42J005-1)	Organic Enrichment/DO Other Inorganics Suspended Solids	Irrigated Crop Production Natural Sources Range Land
Little Powder	Little Powder River (MT42I001)	Flow Alteration Other Organics Salinity/TDS/Chlorides Suspended Solids	Irrigated Crop Production Natural Sources Streambank Modification/Destabilization

TABLE 3-6
IMPAIRED WATER BODIES IN AREA OF MAXIMUM CBM POTENTIAL

Watershed	Impaired Water body	Probable Causes of Impairment	Probable Sources of Impairment
		Siltation	
Lower Powder	Stump Creek (MT42J004-2)	Suspended Solids	Agriculture Range Land
Lower Powder	Lower Powder River (MT42J003-1) from mouth of Little Powder to the mouth	Flow Alteration Metals Nutrients Other Organics Pathogens Salinity/TDS/Chlorides Suspended Solids	Agriculture Irrigated Crop Production Natural Sources Petroleum Activities Resource Extraction Range Land Streambank Modification/Destabilization

Source: Final Year 1996 Montana 303(d) List. A Compilation of Impaired and Threatened Water bodies in Need of Water Quality Restoration, Part A, Water Quality Assessment Results.

In accordance with Section 303(d) of the Federal Clean Water Act, the Montana Department of Environmental Quality (MDEQ) has prepared a list of impaired and threatened waters every 2 years since 1992. This so called "303(d) list" identifies lakes, rivers, and streams that are not meeting water quality standards and establishes priorities for Total Maximum Daily Load (TMDL) development. However, Montana, like the rest of the nation, was slow to develop TMDLs. On June 21, 2000, the U.S. District Court of Montana ordered EPA to work with the State of Montana to develop and adopt a schedule that would result in developing all necessary TMDLs for water bodies on Montana's 1996 Section 303(d) list (Table 3-6) by May 5, 2007. On November 1, 2000, MDEQ and EPA published a schedule that divided the state into 91 TMDL Planning Areas each with a deadline for completing all necessary TMDLs. The surface waters likely to be affected by CBM development are located in the Tongue and Powder TMDL Planning Areas. The TMDL completion dates for these planning areas are 2005 and 2006, respectively, however, based upon concern due to proposed CBM development plans, the MDEQ and EPA are currently developing TMDLs for these streams for SAR and EC. Impacted water bodies and TMDL issues are discussed in detail in the Hydrology Appendix.

Groundwater

Groundwater within the planning area is found within a variety of aquifers, ranging from shallow unconsolidated alluvial aquifers associated with modern rivers to deep bedrock aquifers consisting of consolidated sandstone, limestone, or coal. The occurrence of specific bedrock aquifers and the quality of groundwater produced from these aquifers vary throughout the planning area. Maps 3-9 and 3-10 are maps that show the occurrence of bedrock aquifers and the quality of groundwater produced from these aquifers.

Water enters the aquifers or reservoirs during deposition of the sedimentary unit as formation water that can be salty or fresh. Later, meteoric water can enter the aquifer through outcropping recharge zones where runoff water infiltrates and is conducted into the subsurface. Groundwater comes to the surface by way of natural springs that conduct groundwater onto the surface or into bodies of surface water. Aquifer pressure can be measured in pounds per square inch (psi) or in feet of head and can vary from a low-pressure reservoir where water stands below the top of the reservoir, to an artesian aquifer where water stands above the top of the reservoir, sometimes being above ground surface and flowing from wells. Aquifer pressure can be measured in a monitoring well where water is not normally produced except for testing and sampling. Groundwater can be produced through water wells that pump or convey water from aquifers to the surface.

Water quality and quantity are variable with the primary water quality issue being salinity. Groundwater represents less than 3 percent of the total water use in the State (Solley et al. 1995). Table 3-7 presents data about the quantity of groundwater used in each water-use category on a watershed basis.

Although the use of groundwater only represents 3 percent of the total water use, it is extremely critical because it provides almost 100 percent of the domestic water for farmsteads. It also constitutes the largest percentage of dependable stock water, because the groundwater is not seasonal or affected by drought, like surface water.

The major aquifers within the planning area are the alluvium, the coals and sands of the Fort Union Formation, and the Lower Hell Creek-Fox Hills Aquifer, as shown in Figure 3-5. Table 3-7 contains information about the general depth, yield, geologic materials, and water quality of all aquifers in the Powder River Basin study area.

Surficial aquifers within the planning area consist of Quaternary and Tertiary alluvium, Tertiary fluvial sand and gravel deposits, and Tertiary terrace deposits. These surficial aquifers are located within the floodplains and along the channels of larger streams, tributaries, and rivers, and are among the most productive sources of groundwater within the planning area. The quality of groundwater from surficial aquifers is generally good, but within the Powder River RMP area and Blaine County it can be highly variable (approximately 1,500 mg/l to 2,800 mg/l total dissolved solids (TDS) and 5.0 to 10 SAR). The quality of groundwater from surficial aquifers within the west half of the Billings RMP area, as well as in Park and Gallatin counties, is usually very good. Wells completed in coarse sand and gravel alluvial aquifers can yield as much as 100 gallons per minute (gpm), although yields of 15 gpm are the average. Alluvial deposits associated with old river beds as detached terraces will usually only yield as much as 20 gpm because they are isolated topographically and have limited saturation (Zelt et al. 1999).

The occurrence of specific bedrock aquifers and the quality of groundwater produced from these aquifers vary throughout the planning area. In general, the quality of groundwater produced from bedrock aquifers is best near their recharge or outcrop areas. Groundwater produced near an aquifer's recharge zone has only been in contact with the rocks and minerals in the aquifer material for a relatively short period of time. As a result, the water has not had time to dissolve substantial amounts of soluble salts and minerals and so it remains fresh. The longer the water is in the aquifer, the more time it has to dissolve salts and minerals. In general, the concentration of total dissolved solids increases with distance from an aquifer's recharge or outcrop zone.

The sands and coals of the Fort Union Formation are important aquifers in the Powder River and Billings RMP areas. Groundwater within the Fort Union Formation has been shown to evolve in a predicable manner along its flow path (Van Voast and Reiten, 1988). In general the salinity of the water increases with time and depth as the water, in contact with geologic material, moves through the aquifer. Cation exchange is one of the normal processes that increases salinity, where calcium and magnesium are replaced by sodium, as the groundwater comes into contact with sodium rich shale. However, in deep portions of the aquifers, sulfate is removed by reduction reactions. This reduction causes the salinity of the water to decrease while increasing the ratio of sodium to calcium and magnesium. The result is a moderately saline (EC of ~1,800 to 2,500 mS/cm) sodium-bicarbonate rich water in the coal seam aquifers where coalbed methane is expected to be produced. Wells within the Fort Union Formation may produce as much as 40 gpm, but yields of 15 gpm are more typical. Where confined and artesian conditions exist, wells in the Fort Union Formation will generally flow at less than 10 gpm.

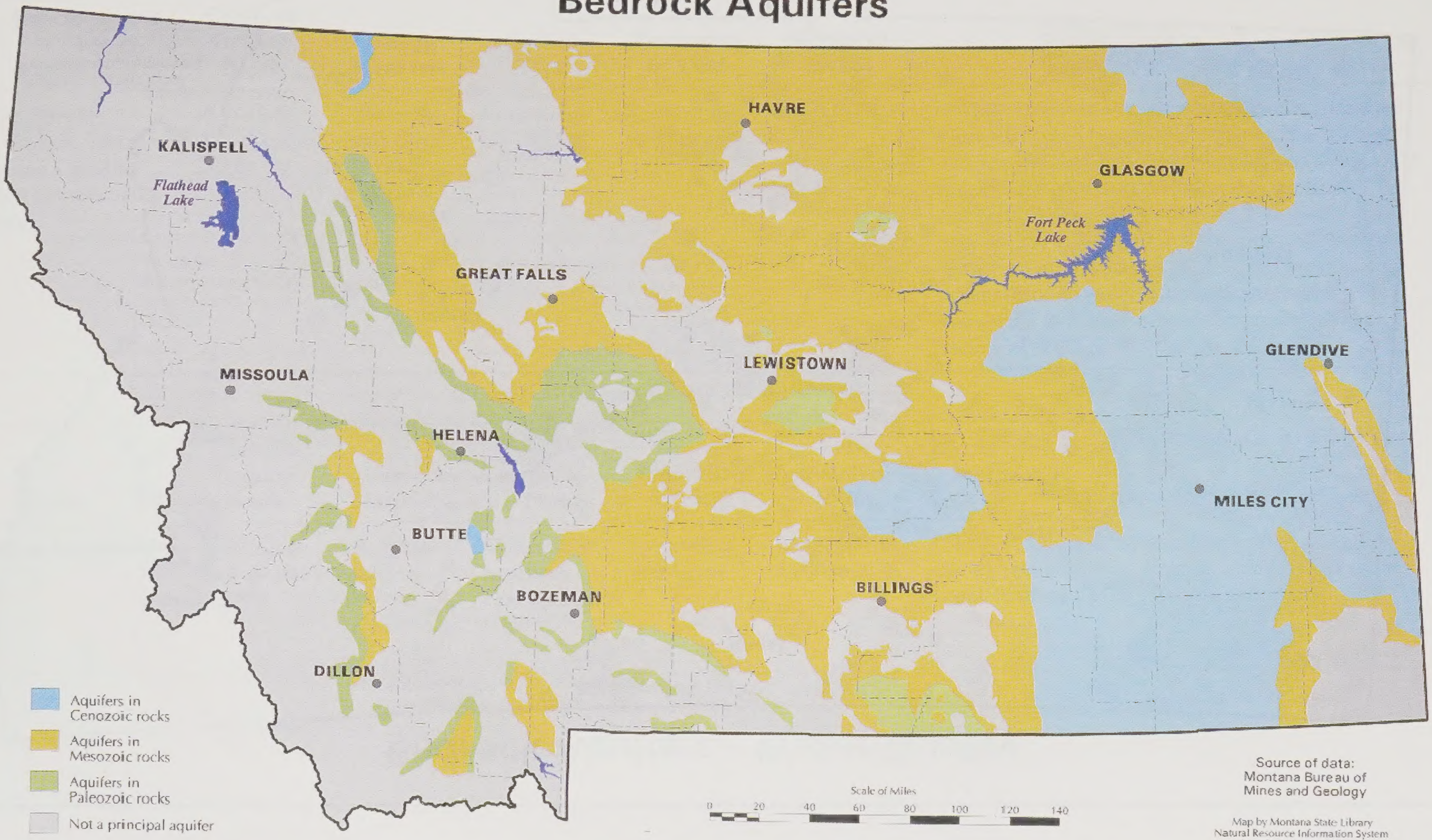
The Lower Hell Creek-Fox Hills aquifer is an important aquifer in the Powder River and Billings RMP areas. The quality of the water derived from the Lower Hell Creek-Fox Hills aquifer is generally good, with TDS levels ranging from 500 to 1800 mg/L. Groundwater yields from this aquifer may be as much as 200 gpm, but 70 gpm is more common. Artesian wells within the Lower Hell Creek-Fox Hills aquifer may yield up to 20 gpm.

The Judith River, Eagle, Kootenai, Ellis, and Madison aquifers are locally important, and details of their hydrologic properties and water quality are listed in Table 3-7.

Of particular importance is the water quality of groundwater within the primary aquifers of the area of main CBM potential; it is these aquifers that may be impacted by CBM development. Table 3-8 listed two of the more important aspects of water quality – TDS and SAR. Further details of water quality are discussed in the Water Resources Technical Report (ALL, 2001b) and in the Surface Water Quality Technical Report (Graystone and ALL, 2002).

Map 3-9

Bedrock Aquifers

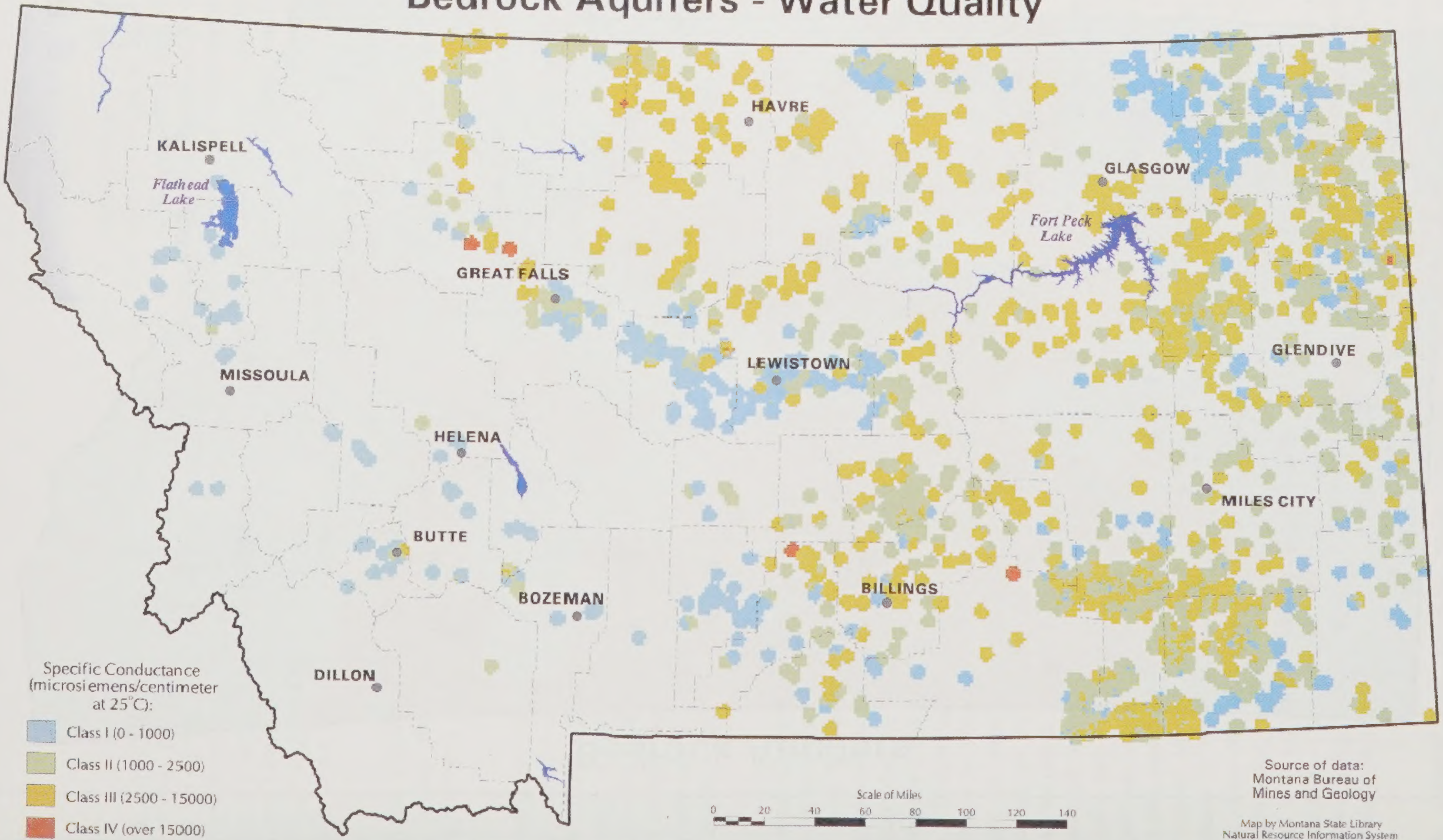

KALISPELL
Flathead Lake
HAVRE
GLASGOW
Fort Peck Lake
GREAT FALLS
MISSOULA
LEWISTOWN
GLENDIVE
HELENA
MILES CITY
BUTTE
BOZEMAN
BILLINGS
DILLON
Aquifers in Cenozoic rocks
Aquifers in Mesozoic rocks
Aquifers in Paleozoic rocks
Not a principal aquifer
Scale of Miles
0
20
40
60
80
100
120
140

Source of data:
Montana Bureau of
Mines and Geology

Map by Montana State Library
Natural Resource Information System
Map #97nris81c - 8/30/96

Map 3-10

Bedrock Aquifers - Water Quality


KALISPELL
Flathead Lake
HAVRE
GLASGOW
Fort Peck Lake
GREAT FALLS
LEWISTOWN
GLENDIVE
MISSOULA
HELENA
MILES CITY
BUTTE
BOZEMAN
BILLINGS
DILLON
Specific Conductance (microsiemens/centimeter at 25°C):
Class I (0 - 1000)
Class II (1000 - 2500)
Class III (2500 - 15000)
Class IV (over 15000)
Scale of Miles
0
20
40
60
80
100
120
140

Source of data:
Montana Bureau of
Mines and Geology

Map by Montana State Library
Natural Resource Information System
Map #97nris81b - 8/30/96

TABLE 3-7
PLANNING AREA AQUIFERS AND THEIR GENERAL CHARACTERISTICS

AQUIFERS IN SURFICIAL DEPOSITS

Aquifer	Common Drilling Depth	Geologic Materials	Aquifer Type	Production or Yield	Total Dissolved Solids	General Comments
Alluvium, Fluvial-Glacial Gravels, Terrace Gravels, and Flaxville Formation Gravels and equivalents.	20 to 40 ft. May exceed 250 ft.	Unconsolidated clay, silt, sand, and gravel.	Commonly unconfined	Typically 5 to 50 gpm.	Range 300 to 2,200 milligrams/ liter (mg/l).	Widely used aquifer systems. Alluvial aquifers are most often used because they lie near the surface and are accessible via shallow wells and water yield is routinely quite good. They can be partially confined to completely confined with yields that may exceed 1,500 gpm in some areas. Yields from gravel deposits are more variable but water quality is usually quite good. Alluvial aquifers are vulnerable to human-caused contamination in a variety of settings.

AQUIFERS IN CENOZOIC ROCKS

Aquifer	Common Drilling Depth	Geologic Materials	Aquifer Type	Production or Yield	Total Dissolved Solids	General Comments
Fort Union Formation	50 to 300 ft. May exceed 1,000 ft.	Interbedded shale, siltstone, sandstone, and coal.	Commonly confined, except near surface.	Typically 5 to 50 gpm.	Range 500 to 5,000 mg/l.	The Fort Union is a major source of groundwater for eastern Montana. Water is suitable for watering stock but may not be suitable for irrigation.

TABLE 3-7
PLANNING AREA AQUIFERS AND THEIR GENERAL CHARACTERISTICS

AQUIFERS IN MESOZOIC ROCKS

Aquifer	Common Drilling Depth	Geologic Materials	Aquifer Type	Production or Yield	Total Dissolved Solids	General Comments
Lower Hell Creek-Fox Hills Formations	150 to 500 ft. May exceed 1,000 ft.	Mainly sandstone with some siltstone and shale.	Confined	5 to 20 gpm. May exceed 200 gpm.	Range 500 to 1,800 mg/l.	Although the Fort Union overlies the Hell Creek-Fox Hills, the latter is often the target for water well drilling as a result of its higher quality of water.
Judith River Formation	200 to 600 ft. May exceed 1,000 ft.	Sandstone, siltstone, with some coal.	Confined	5 to 15 gpm. May exceed 100 gpm.	Range 160 to 27,000 mg/l.	
Eagle Formation	100 to 800 ft. May exceed 2,000 ft.	Interbedded sandstone and shale.	Confined	10 to 20 gpm. May exceed 200 gpm.	Range 800 to 1,500 mg/l.	Water quality is best in central Montana, poorer in eastern Montana.
Kootenai Formation	100 to 1,000 ft. May exceed 3,000 ft.	Interbedded sandstone, siltstone, and shale.	Confined	10 to 30 gpm. May exceed 100 gpm.	Range 200 to 500 mg/l. May exceed 14,000 mg/l.	Used heavily near the Belt Mountains where water quality is good.
Ellis Group	300 to 2,000 ft. May exceed 5000 ft.	Sandstone, shale, limestone, and dolomite.	Confined	No Data.	Generally less than 600 mg/l.	Water quality is best near outcrop areas.

AQUIFERS IN PALEOZOIC ROCKS

Aquifer	Common Drilling Depth	Geologic Materials	Aquifer Type	Production or Yield	Total Dissolved Solids	General Comments
Madison Group	500 to 3,000 ft. May exceed 7,000 ft.	Limestone, dolomite, anhydrite, and halite.	Confined	20 to 6,000 gpm. Higher in karst areas.	Range 500 to 300,000 mg/l.	Very extensive aquifer, it underlies a large portion of the Great Plains. Water quality can be very high near recharge areas and is poorest in northeastern Montana.

FIGURE 3-5

ERA	Period	Principal Aquifers	Age:
CENOZOIC	Quaternary	Alluvium and Fluvial-Glacial Gravels	10,000 Years
	Tertiary	Alluvium Fluvial-Glacial Gravels (and equivalents) Terraces Fort Union Formation	1.6 MYBP
MESOZOIC	Cretaceous	Lower Hell Creek-Fox Hills Formation Judith River Formation Eagle Formation	66.4 MYBP
	Jurassic	Kootenai Formation Ellis Group	
	Triassic	No Principal Aquifers	245 MYBP
PALEOZOIC	Permian	No Principal Aquifers	
	Pennsylvanian	No Principal Aquifers	
	Mississippian	Madison Group	
	Devorian	No Principal Aquifers	
	Silurian		
	Ordovician		
	Cambrian		570 MYBP

MYBP – Millions of Years Before Present

TABLE 3-8
GROUNDWATER QUALITY FOR THE MONTANA PORTION OF THE POWDER RIVER BASIN SELECTED GROUNDWATER QUALITY DATA COLLECTED FROM WATER SUPPLY WELLS LOCATED THROUGHOUT MONTANA POWDER RIVER BASIN

	Judith River Formation		**Hell Creek /Fox Hills Formation**		**Fort Union Formation**		**Quaternary Alluvium**	
County	**Avg. TDS (mg/l)**	**Avg. SAR**	**Avg. TDS (mg/l)**	**Avg. SAR**	**Avg. TDS (mg/l)**	**Avg. SAR**	**Avg. TDS (mg/l)**	**Avg. SAR**
Big Horn	936	54	1,440	14	1,658	8	2,118	5
Rosebud	2,465	31	1,376	35	1,595	16	1,516	9
Powder River	No data	No data	890	35	1,882	15	2,783	5
Custer	No data	No data	896	37	1,810	31	1,665	8
Treasure	2,312	64	1,985	56	1,782	32	2,437	10
Weighted Average	2,100	42	1,148	37	1,892	18	2,014	7

Note:
Avg. TDS = Average Total Dissolved Solids
Avg. SAR = Average Sodium Adsorption Ratio
Source: MBMG 2001

Water Rights

Water rights in Montana are the subject of The Montana Water Use Act (Title 85, Chapter 2, MCA) of 1973, which became effective July 1, 1973. Water rights existing prior to that date are to be finalized by state courts. Water rights applications since that date are secured through a MDNRC permit system. In addition, some water rights are protected under federal and state statutes.

Water rights on some BLM lands are protected by the Federally Reserved Water Rights for Public Springs and Water Holes, Public Water Reserve 107, pursuant to Executive Order dated April 17, 1926. Compacts between the State of Montana and Northern Cheyenne Tribe have placed moratoria on new water use developments on Tribal Lands within the Rosebud, Lower Bighorn, and Pryor watersheds. Native American water rights are discussed in detail in the Indian Trust Assets section of this chapter.

Water rights are being adjudicated on a watershed basis. The Tongue River and Little Bighorn have not yet been fully adjudicated, Rosebud is 78 percent examined prior to being adjudicated, Lower Yellowstone is 90 percent examined. Table 3-9 lists water rights developments by watershed in the area of main potential for CBM production. Native American Water Rights are discussed in detail in the Indian Trust Assets section of this chapter.

The Montana Water Use Act (85-2-506) established the designation of the Powder River Basin Controlled Groundwater Area. The MDNR established in the Controlled Groundwater Area in anticipation of the withdrawal of groundwater associated with CBM development. Two issues relating to water rights were addressed as part of the order. First, CBM operators must offer water mitigation agreements to owners of water wells and natural springs within 1/2 mile of a CBM field proposed for approval by the MBOGC or within the area that the operator reasonably believes may be impacted by a CBM production operation, whichever is greater. Second, beneficial uses of CBM-produced water require water rights issued by MDNRC as established by law.

TABLE 3-9
WATER RIGHTS DEVELOPMENT SUMMARY BY WATERSHED

Watershed	Number of Pre-1973 Developments		Number of Post-1973 Developments		Number of Pending Water Rights Permits
	Surface	**Ground-water**	**Surface**	**Ground-water**	
Rosebud	765	408	27	210	1
Upper Tongue River	820	504	35	136	3
Lower Tongue River	2,407	2,278	98	662	1
Little Powder	1,320	741	66	166	3
Lower and Middle Powder and Mizpah	5,204	2,816	314	4	7
Lower Yellowstone	3,398	1,330	278	804	4
Little Bighorn	786	387	35	96	0
Lower Bighorn	1,522	596	105	419	3

DNRC 2001

Indian Trust Assets

The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines Indian Trust Assets (ITAs) as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians. DOI Departmental Manual 512 DM 2 requires all of its bureaus and offices to explicitly address anticipated effects on ITAs in planning, decision, and operating documents.

Beyond the maintenance of tangible assets, the federal government also has a trust responsibility to be considerate of the general well being of the tribes. This responsibility includes recognizing the Indian culture as an important value and to carefully consider Indian cultural values when conducting planning efforts. Indian cultural values include their unique way of life, ceremonial practices, spiritual beliefs, family values, and worldview. The DOI Department Manual 512 DM 2 also asserts an affirmative responsibility to ensure the tribal health and safety, to consult on a government-to-government basis with tribes who may be affected by proposed actions, to disclose all applicable information and to fully incorporate tribal views in its decision-making processes.

Background

Lands associated with a reservation or public domain allotments are examples of ITAs. Natural resources that exist within Indian reservations such as standing timber, minerals, and oil and gas are ITAs. Treaty rights, water rights, and hunting and fishing rights may also be ITAs. Other ITAs may consist of financial assets held in trust accounts or intangible items such as Indian cultural values, ITAs are a product of the unique history and relationship of the U.S. government with various American Indian tribes. There is no similar relationship between the Montana State government agencies and sovereign dependent Indian tribal nations (like the Northern Cheyenne and Crow Tribes). See Map 1-1 for the general location and boundaries of the reservations, and Table 3-10 for ITA acreages.

Identification Methods

The BIA is required to develop inventories of ITAs for all Indian tribes. The only ITAs in the EIS emphasis area are the actual Indian reservation lands, natural resources and rights belonging to the Assiniboine, Northern Cheyenne, Crow, Gros Ventre, and the Turtle Mountain tribes.

Applicable Laws

Federal

The DOI Department Manual 512 DM 2 requires all DOI Bureaus and offices to explicitly address anticipated effects on ITAs in planning, decision, and operating documents. This order also requires descriptions of how decisions will conform to the DOI's trust responsibilities. Furthermore, DOI Department Manual 303 DM 2 outlines the principals for managing ITAs.

TABLE 3-10
INDIAN TRUST ASSETS

Tribe	Acreage of Reservation	Trust Acres	Tribal Surface Acres	Individually Allotted Surface Acres	Tribal Mineral Acres	Individually Allotted Mineral Acres	Fee Acreage
The Northern Cheyenne	445,000	442,193	444,000	138,211	444,000	138,211	2,087
The Crow	2,296,000	1,491,569	455,719	1,035,850	405,888	824,427	804,431
Fort Belknap Community Council	623,000	618,228	232,799	385,429	54,351	369,044	4,772
Turtle Mountain Public Domain Allotments	N/A	61,520	N/A	61,520	N/A	61,520	N/A

Source: Madison 2001

State

ITAs are not considered under any State standards or regulations.

The Crow Tribe

The Crow Reservation is located in south-central Montana, and comprises nearly 2,296,000 acres. Access is via Interstate 90 or U.S. Highway 87. The reservation is bordered on the south by the State of Wyoming, on the east by the Northern Cheyenne Reservation, and on the northwest by the city of Billings, which is Montana's largest metropolitan area. The reservation encompasses the Little Big Horn Battlefield and approximately 3,600 square miles of rolling prairie and rugged foothills drained by the Bighorn River. The BIA Realty Office indicated that the tribe has some 455,719 surface acres and 405,888 acres of mineral rights. There are another 1,035,850 acres that have been individually allotted, and 824,427 acres of allotted mineral rights.

There are about 10,083 Crow tribal members, the majority of which live on the reservation. The Crow language is spoken by more than 80 percent of the tribe. Headquarters are at Crow Agency, Montana, just south of Hardin, Montana. The total labor force on the Crow Reservation is 3,902. The unemployment rate is 61 percent. The average per capita income is $4,243.

Water Rights

The Crow have existing water rights held in trust, similar to the Northern Cheyenne. The Crow Tribe has not negotiated a water rights compact with the State of Montana.

Mineral Rights

The BIA Realty Office has stated that the Crow have mineral right assets totaling some 405,888 subsurface acres and another 824,427 allotted mineral acres.

Cultural Resources

The Crow also considers cultural and prehistoric resources located within their reservation to be ITAs. At present, an unknown number of archaeological resources are on the reservation. Sites are known to exist on the reservation, but the tribe reserves the information. These sites can consist of burials, trails, rock features, lithic scatters, house pits/rings, rock-shelters, caves, bison kills, and petroglyphs.

The Northern Cheyenne Tribe

The Northern Cheyenne Indian Reservation occupies about 445,000 acres in eastern Big Horn and southern Rosebud counties, Montana. Access is provided by U.S. Highway 212. The reservation covers nearly 695 square miles and is bordered on the east by the Tongue River and on the west by the Crow Reservation. According to the BIA Realty Office, the tribe has 442,193 trust acres and 444,000 of surface and mineral estate lands. There are 138,211 individual allotted acres on the reservation.

The total tribal population is 7,473, of which approximately 4,212 Northern Cheyenne live on or near the reservation. The tribal headquarters are in the town of Lame Deer. The total work force of the tribe is approximately 2,437 and the unemployment rate is 71 percent according to the BIA Indian Labor Force Report (BIA 1999). The per capita income is estimated at $4,479.

Water Rights

The Northern Cheyenne Tribe has existing water rights held in trust by the U.S. The 1908 U.S. Supreme Court ruling in *Winters v. U.S.* (207 US 564) ruled that water rights needed to develop Indian reservations were reserved, and this includes both groundwater and surface water rights.

The Northern Cheyenne have a water rights compact with the State of Montana and own a significant amount of water in the Tongue River Basin, including a principal portion of the Tongue River Reservoir.

The Northern Cheyenne Tribe has developed draft water quality standards and is currently discussing an agreement with the State of Montana and the BLM regarding preservation of beneficial uses. The draft water quality standards have not been submitted to the EPA for approval

Mineral Rights

The Indian Minerals Development Act (PL 97-382, 25 USC 2101) and the Federal Oil and Gas Royalty Management Act of 1982 (PL 97-451) provide that information about mineral development of Indian Trust lands are proprietary to the individual tribe and may not be disclosed without consent. The BIA Realty Office has stated that the Northern Cheyenne have mineral right assets totaling some 444,000 subsurface acres.

Cultural Resources

The Northern Cheyenne Tribe considers cultural resources located within their reservation to be ITAs. Sites are known to exist on the reservation, but the information is reserved by the tribe. These sites can consist of burials, trails, rock features, lithic scatters, house pits/rings, rock-shelters, caves, bison kills, and petroglyphs.

Fort Belknap Community

The Fort Belknap Indian Reservation is positioned in north-central Montana near the Canadian border between the Milk River and the Little Rocky Mountains. The reservation is in Blaine and Phillips counties. The trust acreage of the reservation is roughly 618,228 acres (Madison 2001). The land is predominately rolling prairie with good grass and brush cover. There are 232,799 tribal-owned surface acres and an additional 385,429 individually allotted surface acres. The mineral rights include 54,351 tribal acres and 369,044 allotted acres.

The reservation houses two tribes that operate under one central government. The two tribes are the Gros Ventre and the Assiniboine. The combined enrollment of the two tribes is approximately 5,133 (Fort Belknap Indian Community 2001). The tribal headquarters are located at the Fort Belknap Agency, 3 miles southeast of Harlem, Montana, on U.S. Highway 2. The total labor force on the Fort Belknap Reservation is 721 and the per capita income is $4,536. The unemployment rate is 29.5 percent.

The tribes' economy is based on agriculture, which includes farming, ranching, and land leasing, including grazing permits. Crops include wheat, hay, and barley. The reservation's climate, as with most of north-central Montana, is subject to severe weather extremes, with hot, dry summers and harsh winters. Both fishing and hunting are popular, and trout, deer, antelope, and some migratory waterfowl are plentiful.

Water Rights

Fort Belknap Reservation is where the 1908 U.S. Supreme Court decision in *Winters v. U.S.* (207 US 564) was originally contested regarding Indian water rights. As noted previously, the waters are a federally reserved trust asset.

Mineral Rights

The BIA Realty Office has stated that the Assiniboine and Gros Ventre have mineral right assets totaling about 54,351 subsurface acres and another 369,044 allotted mineral acres.

Cultural Resources

The Assiniboine and Gros Ventre consider cultural and prehistoric resources located within their reservation to be ITAs. The number of archaeological resources on the reservation is unknown. The tribes reserve information about cultural sites. These sites can consist of burials, trails, rock features, lithic scatters, house pits/rings, rock-shelters, caves, bison kills, and petroglyphs.

The Turtle Mountain Public Domain Allotments

There are approximately 61,520 acres (Madison 2001) of trust lands allotted to the members of the North Dakota Turtle Mountain Tribe scattered throughout 2,000 square miles of Montana.

In 1906, the Burke Act provided that individual tribe members could receive allotments of reservation land. At that time, parcels of 160 acres each were allotted to individuals of the Turtle Mountain Tribe in Montana. These allotments, although not grouped as a reservation, are within the planning area. These Trust lands are subject to the same leasing and development procedures as for the reservations.

Lands and Realty

A variety of land uses exist throughout the planning area, including agricultural (crops and grazing); roads and highways; railroads; utility rights-of-way (ROW) for electrical power lines and telephone; communication sites; oil and gas production and pipelines; residential; commercial and light industrial uses; mining; municipalities; and recreation.

Table 3-11, *Land Ownership*, shows surface ownership in acres by county for federal, state, tribal, and private lands. It also shows that approximately 65 percent of the land is private land. The majority of the private land is agriculturally based (grazing and crops). The next largest ownership is federal lands at 20 percent. Federal lands include lands managed by the BLM, U.S. Forest Service (USFS), National Park Service, U.S. Bureau of Reclamation (USBR), and U.S. Fish and Wildlife Service (FWS). BLM and USFS lands are used for grazing, timber production, mineral production (except for the Custer National forest, which is excluded from surface coal mining by Section 522 of the SMCA of 1977), and year-round recreation activities; USBR lands are used for water storage and recreation; National Park Service lands are used for recreation; and FWS lands are used for wildlife refuges and recreation.

Tribal lands comprise 10 percent of the land in the planning area. They are used for cattle production, mining, logging and lumber production, residential, and recreation on the Northern Cheyenne Reservation. Major land uses on the Crow Reservation include agriculture, mining, and recreation (Madison 2001).

State lands comprise the least amount of land in the planning area at 5 percent. This land is used for grazing, mining, timber production, oil and gas production, state parks, and recreation activities. State lands are composed of school trust land administered by DNRC Trust Land Management Division, land owned by DNRC Water Resources Division, and land owned by other state agencies. Uses vary by agency. School trust land uses include agriculture, grazing, mineral exploration and mining, aggregate production, recreational activities, oil and gas exploration and production, timber production, and special uses, for example, wind turbines for energy production. School trust lands also have pipelines, power lines, telephone lines, roads and highways, home site leases, and cabin site leases, depending on the situation.

Roads and highways include interstate, U.S., state, and off-system roads open to the public—county, local, and private roads open to public use. Table 3-12 lists the number of miles of each type within the planning area.

Railroad ROW crisscross the counties in the planning area. Railroads in the planning area transport goods such as grains, intermodal containers, and coal. Table 3-13 indicates the approximate miles of railroad ROW within the planning area for each county, by railroad.

There are existing gas pipelines in all the counties being studied. Some existing roads, utilities, and gas lines could be used as part of the network for new CBM installations.

TABLE 3-11
LAND OWNERSHIP

		Federal					Managed by State			Managed by Tribal			
County	**Total Acres**	**BLM**	**Forest Service**	**National Park Service**	**Bureau of Reclamation**	**U.S. Fish & Wildlife Service**	**Lands**	**Water**	**State Park**	**Federal Government Holdings**	**Tribal Land**	**Private**	**Unknown**
Big Horn	3,208,115	61,617	12	762			97,483	16,535	3,733	1,996	1,565,898	1,459,556	523
Blaine	2,711,111	465,021		204		2,700	173,811	12,138		19	498,968	1,558,250	
Carbon	1,319,367	222,309	323,729		6		42,463	9,099	382		121	700,233	21,025
Carter	2,132,128	505,614	90,246				141,754	5,736	372			1,388,406	
Custer*	1,556,352	188,226	46,332				89,787	3,245				1,228,762	
Gallatin	1,682,769	9,026	607,719	62,927			52,793	16,549	7,825			925,930	
Golden Valley	752,094	8,182	23,570			303	48,898	1,523				669,618	
Musselshell	1,196,032	102,932				13,586	75,742	3,642				1,000,130	
Park	1,799,785	13,459	752,830	93,555		1,113	33,172	6,587				899,069	
Powder River	2,109,880	258,817	340,424				141,034	560				1,369,045	
Rosebud*	1,502,305	83,857	95,575				64,807	3,031			242,132	1,012,903	
Stillwater	1,154,243	5,986	191,973		12	3,800	45,600	11,531				895,341	
Sweetgrass	1,190,833	16,116	281,586				47,836	4,502	135			840,658	
Treasure	629,224	12,252	1,323				36,955	3,635			1,600	573,459	
Wheatland	913,079	1,415	65,397				74,379	3,446	1,329			767,113	
Yellowstone	1,693,991	86,924			1,487	284	80,042	9,034	41		134,010	1,382,169	
Total:	25,551,308	2,041,753	2,820,716	157,448	1,505	21,786	1,246,556	110,793	13,817	2,015	2,442,729	16,670,642	21,548

Data Sources: Land Ownership, Highways and Railroad ROW, Montana State Library/NRIS, Helena, Montana. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale Land Ownership, Highways, and Railroad ROW.

*Acreage reflects only that portion of this county included in the planning area.

TABLE 3-12
MILES OF ROAD/HIGHWAY

County	Interstate	U.S.	State	Off-System
Big Horn	81.8	38.7	21.7	925.0
Blaine		54.5	39.3	1,359.0
Carbon		107.6	46.0	833.0
Carter		38.3	12.1	694.0
Custer	42.8	25.5	51.8	824.0
Gallatin	43.6	115.0	67.2	1,441.0
Golden Valley		29.2	12.4	483.0
Musselshell		99.5	1.6	554.0
Park	32.4	104.0	6.7	781.0
Powder River		64.6	55.1	718.0
Rosebud	41.9	26.2	51.3	1,052.0
Stillwater	38.1		23.0	858.0
Sweetgrass	37.1	31.8		516.0
Treasure	26.2			244.0
Wheatland		79.8		449.0
Yellowstone	95.2	29.8	41.7	1,826.0
Total	**439.1**	**844.4**	**430.0**	**13,557.0**

Data Sources: Land Ownership, Highways and Railroad ROW, Montana State Library/NRIS, Helena, Montana, 2001. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale Land Ownership, Highways, and Railroad ROW.

TABLE 3-13
MILES OF RAILROAD ROW

County	**Railroad** **BNSF**[1]	 **Montana Rail Link**	 **Tongue River Railroad (Proposed)**
Big Horn	119		19
Blaine	62		
Carbon	61		
Custer	32		44
Gallatin		72	
Golden Valley	70		
Musselshell Park		34	
Rosebud	39		64
Sweetgrass		32	
Treasure	36		
Yellowstone	32	50	
Totals	419	188	127 (proposed)

Data Sources: Land Ownership, Highways and Railroad ROW, Montana State Library/NRIS, Helena, Montana. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale Land Ownership, Highways, and Railroad ROW.

[1] BNSF—Burlington, Northern, and Santa Fe Railroad.

Livestock Grazing

Most grazing allotments involve only one permittee; however, there are several multi-permittee allotments. There are no other rights or control of public lands granted by issuance of a grazing permit. The length of grazing periods varies from seasonal to year-long use. Most ranch operators using the allotments are cow-calf operations with sheep operations coming in second.. Most allotments have several range improvements such as fences, stock ponds, pipelines, springs, windmills, seedings, wells, and access roads for better control of livestock for management purposes (BLM 1992).

In the planning area, approximately 1,205 allotments cover 1.6 million acres of federal lands (Tribby 2001, Padden 2001, Haas 2001).

These allotments are used to graze cattle, sheep, and horses. The main class of livestock using public lands is cattle (93 percent). Authorized livestock use on the grazing allotments totals about 288,000 animal unit months, which include active-use, non-use, and exchange-of-use options (Tribby 2001, Padden 2001, Haas 2001). An animal unit month is the amount of forage necessary to support one cow and her calf, or five sheep, for one month.

The TLMD regulates the grazing rights for the trust land resources in the State. For the RMP areas and three additional counties, there is a total of 1,207,400 acres of classified grazing and forested lands, and 323,941 animal unit months. Grazing use of trust lands for the entire state includes approximately 8,500 agreements during the year 2000. The 4.3 million acres of classified grazing and forested lands have an estimated carrying capacity of 1,090,000 animal unit months (Chappell 2001).

Native Americans

There are seven federally recognized Indian tribal organizations in Montana. They are the Assiniboine and Sioux Tribes of Fort Peck (Sioux Division of Sisseton/Wahpetons, the Yantonias, the Teton Hunkpapa, and the Assiniboine bands of Canoe Paddler and Red Bottoms), the Blackfeet Tribe, the Chippewa Cree Tribe, the Confederated Salish and Kootenai, the Crow Tribe of Montana, the Fort Belknap Indian Community (the Assiniboine and the Gros Ventre), and the Northern Cheyenne Tribe. Non-federally recognized tribes also reside in Montana: the Little Shell Band of Chippewas of Montana and the Metis.

Tribal enrollment within these organizations is recorded as 61,203 individuals or nearly 6.6 percent of the state's population. Within this population there is an average unemployment rate of 61 percent and a high level of poverty (BIA 1999).

The majority of these native people reside on seven Indian reservations throughout Montana. The reservations are the Crow, Northern Cheyenne, Fort Peck, Fort Belknap, Rocky Boys, Blackfeet, and the Flathead. Three reservations are within the planning areas of the State of Montana and the BLM: the Crow, Northern Cheyenne, and Fort Belknap. Of particular interest are the Crow and Northern Cheyenne reservations that are located within the CBM emphasis area of the Powder River Basin.

The Crow Indian Reservation

Much of the information in this section has been summarized from the Crow Indian Reservation's *Natural, Socio-Economic and Cultural Resources Assessment and Conditions Report* (Crow Tribe 2002). Readers should refer to that document for more detailed information. This document can be downloaded from the MDEQ CBM web page at http://www.deq.state.mt.us/CoalBedMethane/index.asp

The Crow Reservation is located in south-central Montana, and comprises nearly 2,296,000 acres. Access is via Interstate 90 or U.S. Highway 87. The reservation is bordered on the south by the State of Wyoming, on the east by the Northern Cheyenne Reservation, and on the northwest by the city of Billings, which is Montana's largest metropolitan area. The reservation encompasses the Little Big Horn Battlefield and approximately 3,600 square miles of rolling prairie and rugged foothills drained by the Bighorn River. The BIA Realty Office indicated that the tribe has some 455,719 surface acres and 405,888 acres of mineral rights. There are another 1,035,850 acres that have been individually allotted, and 824,427 acres of allotted mineral rights.

Mountains, residual uplands, and alluvial bottoms make up the topography of the Crow Reservation. The three principle mountain areas are the Wolf Mountains (CHEETIISH) to the east and the Big Horn (BASAWAXAAWUUA) and Pryor Mountains (BAAHPUUO ISAWAXAAWUUA) to the south. Sloping downward to the north from the mountains are rolling upland plains. The plains constitute the bulk of the reservation and vary in altitude from 3,000 to 4,500 feet. The alluvial bottomlands are located along the Big Horn River, Little Big Horn River, and Pryor Creek drainage systems.

Reservation communities include Crow Agency, Saint Xavier, Yellowtail (Fort Smith), Lodge Grass, Wyola, and Pryor. The Crow Tribe recognizes six districts within the reservation. The six districts are Big Horn, Black Lodge, Lodge Grass, Pryor, Reno and Wyola. (Crow Tribe 2002).

Tribal Government

The U.S. signed treaties in 1825, 1851, and 1868 with the Crow Tribe. These legal documents define the tribes' relationship with the U.S., recognized their rights as a sovereign government, and established reservation boundaries. The U.S. first recognized the Crow Tribe by Treaty in 1825 (ratified August 4, 1825. 7 Stat. 266, proclaimed February 6, 1826), and this recognition has continued through today as evidenced by the Federal Register notice of July 12, 2002. The Treaty of 1851 established the Crow Reservation. The Tribal government has authority within the boundaries of the reservation for all ROW, waterways, watercourses, and streams, running through any part of the reservation.

The Crow Tribe of Indians repealed its 1948 constitution and By-Laws in July 2001. The Crow Constitution of 2001 established a three-branch government, Executive, Legislative, and Judicial. Each branch possesses separate and distinct power. Elected Executive and Legislative branch officials hold 4-year terms. Tribal judges, who serve for life, are selected by the Tribal Chairman and confirmed by a majority vote of the Legislature. Judgeships consist of a Chief and Associate Judges. Crow Tribal Law and Order Code direct the Tribal Court.

The Legislature consists of 18 representatives from six Legislative Districts (three representatives from each district) in the reservation. The Legislative Branch promulgates and adopts laws, resolutions, ordinances, codes, regulations, and guidelines in accordance with the 2001 Constitution and federal laws. These legislative measures include taxes and licensing to protect and preserve property, wildlife, and natural resources.

The Executive Branch includes a Chairman, Vice-Chairman, Secretary, and Vice-Secretary. The Executive Branch is empowered to administer funds, and to enforce laws, ordinances, resolutions, regulations, or guidelines passed by the Legislative Branch.

Demographics

As of 2000, 69 percent of the 10,220 enrolled members of the Crow Tribe were living on the Crow Indian Reservation (reservation). The off-reservation population of enrolled members included 850 (8 percent) in Hardin, and 2,340 (23 percent) in other areas, primarily Big Horn County, Billings (Yellowstone County), and other Montana and Wyoming counties near the reservation. In the 2000 Census, the reservation's population was 6,890, an increase of 15 percent from 1980. Native Americans made up 75 percent of the reservation's population. Ninety-four percent of the reservation's population was in Big Horn County and the other 6 percent in Yellowstone County.

Between 1990 and 2000, the population of the Crow Indian Reservation increased by 520 (8 percent) compared to an 11.8 percent increase for all of Big Horn County. Average annual population growth has been less than 1 percent since 1980. The median age on the reservation is 27.6, compared to 37.5 for Montana as a whole. The population is distributed between the reservation communities of Crow Agency, Dunmore, Garryowen, Lodge Grass, Wyola, Pryor, Saint Xavier, and Yellowtail and rural areas outside of the communities.

In the 1990 Census, 41.7 percent of persons on the Crow Indian Reservation were living below the poverty level. Poverty status on the reservation as determined by the BIA for 1999 was 38 percent (see Table 3-14).

Social Organization

As of 2000, there were 2,280 housing units on the reservation. Of these, 1,320 (58 percent) were owner-occupied, 24 percent were rented-occupied, and 18 percent were vacant (presumably due to substandard conditions). Household size in 2002 was 3.5 for owner-occupied and 3.9 for renter-occupied. The reservation has a shortage of adequate housing for the needs of the population. The Crow Tribal Housing Authority identified 250 homes with more than one family in the households in 2002 and a waiting list of 300 families in need of housing. In 1997, the BIA identified a need for 1,040 new housing units on the reservation and 890 families in need of housing. Temporary housing off the reservation is available in Hardin, just north of the reservation in Montana, and in Sheridan, Wyoming, about 25 miles south of the reservation.

The Crow Indian Reservation Natural, Socio-Economic and Cultural Resources Assessment and Conditions Report describes in detail the public facilities and services in five of the larger communities on the Crow reservation. Telephone, gas, and electric utilities are provided by a variety of county and other utility companies. Educational facilities include elementary, junior high, and high schools and Little Big Horn Community College. Varying levels of public water and sewer systems are provided, depending on the community. Some of these systems are in need of maintenance and repair. The communities also have varying levels of medical, police, and fire protection services.

The reservation has eight elementary schools, three high schools, and the Little Big Horn Community College. The three high schools are located in Lodge Grass, Pryor, and Hardin. From coal mining revenues, the schools at Hardin and Lodge Grass have become two of the wealthiest in the state. Public schools are also available in both Billings and Hardin. Approximately 70 percent of members have a high school diploma and more than 6 percent have a Bachelor's Degree or higher.

Economics

The most recent employment information for the reservation is from the 1990 Census. In 1990, total employment on the reservation was 1,660. The tribal and federal governments are the largest employers. The Crow tribal government employed 400 persons in 2002. Agriculture (330, 20 percent), education (240, 15 percent), and retail trade (230, 14 percent) were the largest industry sectors. Private wage and salary (780, 47 percent) and government (590, 36 percent) were the largest classes of employment. According to the 1990 Census, the reservation's labor force (persons 16 years and older) was 2,380, with an unemployment rate of 30.4 percent. Much higher rates (61 percent) are reported by BIA statistics from 1999 (see Table 3-15).

TABLE 3-14
TRIBAL POVERTY RATES AMONG THOSE EMPLOYED (1999)

Tribe	County	Total Tribal Enrollment	Percent Employed but Below Poverty Guideline
Crow Tribe of Montana	Big Horn County, Yellowstone County	10,083	38%
Northern Cheyenne Tribe	Big Horn County, Rosebud County	7,473	26%
Fort Belknap Indian Community	Blaine County	5,223	40%
Montana (all tribes)		61,203	33%

Source: BIA 1999.

TABLE 3-15
AVERAGE ANNUAL UNEMPLOYMENT RATES BY RESERVATION

	1996 Rate (%)	1999 Rate (%)	Change 1996-1999
Crow Reservation	15.5	14.9	0.6
Northern Cheyenne Reservation	26.0	18.7	7.3
Fort Belknap Reservation	27.2	22.9	4.3

Source: Montana Department of Labor & Industry, Research & Analysis Bureau, Local Area Unemployment Statistics (2001a)

Page 3-38 of the Statewide Draft Oil and Gas EIS states that tribal members' 1999 per capita income was $4,243. By comparison, per capita income for Big Horn County was $13,329 and the State of Montana was $21,229. In the 1990 Census, median household income for the reservation was $17,270, compared with $19,900 for Big Horn County and $22,988 for the state.

Agriculture has been the historic base of the reservation economy. Agricultural crops include livestock, wheat, barley, oats, corn, sugar beets, alfalfa, and hay. In 2000, the Montana State University/Big Horn County Agricultural Extension Service estimated the values of crops and livestock on the reservation were $20.9 and $35.5 million, respectively.

Natural resources (land, water, coal, oil and gas, timber, and sand and gravel) also contribute to the employment base and income on the reservation. The Absaloka Mine is located within 5 miles of the reservation's northern boundary and employs between 40 and 75 Crow tribal members. The Stateside Draft Oil and Gas EIS (p. 3-40) states there have been 172 conventional oil and gas wells drilled on the reservation. These wells have been drilled by non-Indian interests through leases with the Crow Tribe. In 1985, 20 companies had 709 oil and gas leases with the Crow Tribe. The reservation has about 36,000 acres of commercial forest in the Wolf and Pryor mountains; timber units are generally leased to non-Indian interests for harvesting.

The Crow Tribe receives government revenue from its natural resources through numerous land leases, boundary settlement allotments, and income-producing trusts generated through coal, mineral, oil, gas, and timber reserves. The majority of these trusts are administered by the U.S. Government's Office of Trust Fund Management.

The Crow Tribe's economic development plans incorporate the reservation's resources such as agriculture, energy, tourism and recreation, and commercial enterprises. The tribe is currently working with programs from federal agencies to prepare a strategy for comprehensive economic development. As part of the federal Economic Development Administration's community economic development strategy (CEDS), the tribe is preparing an economic development plan to balance development and protection of the reservation's resources.

Air Quality

The air quality and climate of the Crow Reservation is similar to that of the regions described earlier in Chapter 3. The Crow Reservation is classified as a PSD Class II area.

The reservation is located in a part of Montana that has a moderate climate relative to its latitude. Snow rarely accrues for long periods of time because of the warm Chinook winds, which originate from the mountains in the West. This portion of Montana is also known for its "Indian Summers" which frequently extend into November. The mean annual temperature is 45.5°F with a summer high of 110°F and a winter low of -48°F. The bulk of the reservation varies from 12 to 18 inches annual precipitation, depending on the elevation.

CBM development activities would need to meet the air emission standards set in the Crow Tribe's Law and Order Code, Section 11. These regulations limit particulate matter and sulfur dioxide emissions from combustion equipment, as well as set visible emissions limits. The tribe is currently in the process of developing and rewriting its codes and standards for air pollution.

Culture and History

The Crow Tribe's native name is the Apsalooke, literally translated, "children of the large beaked bird." Early explorers mistook the signing for Apsalooke, the flapping of one's hands like the wings of a bird in flight, and called them the Crow. The Crow were historically recognized as matrilineal and their social system was clan based. The original 13 clans of the Crow Tribe are as follows:

- Ashilaaliio—Newly Made Lodges
- Ashshitchite—Big (husky) Lodges
- Ashiiooshe—Sore (burnt) Lip Lodge
- Uuwuutashshe—Greasy Mouths
- Uussaawaachia—Brings Game Home Without Shooting
- Xuhkaalaxche—Ties Things Into a Bundle
- Ashpeennuushe—Filth Eaters
- Ashkapkawia—Bad War Deeds
- Bilikooshe—Whistling Water
- Ashxache—Hair Left on the Hide Lodge
- Ishaashkapaaleete—Cropped Ear Pets Lodge
- Ishaashkakaawia—Furious Pets Lodge
- Ashbatshua—Traitorous Lodge

Of these three are extinct and the remaining 10 recognized clans have been consolidated into the following six; Bad War Deeds, Big Lodges, Greasy Mouths, Ties Things Into a Bundle, Traitorous Lodge, and Whistling Water. (Reed, G. 2002)

The Crow people were originally party of the Hidatsa Tribe, which originated in the upper mid-west of the present U.S. Their subsistence and lifestyle was agriculture based. The Mountain Crow separated from the Hidatsa in North Dakota in the 1550s into eastern Montana and during the 1600s expanded along the Yellowstone River drainage. The River Crow moved into central Montana in 1670 and by 1720 were concentrated in the Yellowstone and Bighorn River drainages.

With the introduction of the horse, people in the Plains tribes became more mobile and began intruding on each other's hunting grounds. The Crow became known for their skill with horses. By 1800 the Powder, Bighorn, Yellowstone, and Wind River drainages became areas of continuing conflict between the Lakota, Northern Cheyenne, Arapaho, Blackfeet, Gros Ventre, Assiniboine, and Crow.

In 1806, the Lewis and Clark expedition spent one month in the Crow Territory, which aided in the Crow developing good relations with fur traders. Fur trading posts were established and fostered the development of the Crow as middlemen in the regional transfer of goods and the Crow prospered. The 1840s saw a period of massive small pox and flu epidemics in which, along with battles between native peoples, the majority of Crow died.

Treaties were signed with the U.S. in 1825, 1851, and 1868. The 1825 Treaty, a treaty of friendship, established a relationship with the U.S. Government. In the Fort Laramie Treaty of 1851, the Crow lost control of the Powder River Basin but gained a promise of peace and annuities that were to be supplied for 50 years. The treaty resulted in some gains but friction continued from tribes who were attracted to the game in the region and by wagon trains of gold seekers making their way to the California or other gold fields. The Crow were busy protecting their territorial boundaries.

Continued conflict in the region led the U.S. government to propose the Fort Laramie Treaty of 1868, which provided territories for individual tribes and closed the Bozeman trail and its forts. In this treaty, the Crow lost lands north of Yellowstone, south of the Montana territorial border, and east of the 107th Meridian.

In 1869, the U.S. government established the Crow Agency near present-day Livingston, Montana. Conditions became sufficiently bad on the reservation that by 1872 the River Crow returned to their Missouri River hunting grounds while the Mountain Crow attempted farming on the reservation. In 1876, the Crow joined the U.S. in a war against the Sioux, Cheyenne, and Arapaho.

The Crow struggled against tradition and the elements to develop farming on the reservation and at times obtained permission to leave the reservation to hunt. White settlers and miners continued to place pressure on the Crow lands. The crow ceded the western boundaries of their land, one-quarter of their reservation, in the How-How Treaty of 1882 in exchange for houses and livestock. In the 1891 Act, the Crow ceded the western third of their reservation and in 1905 more land was ceded.

In the Crow perception of the world there is not a clear distinction between the western perception of spiritual and physical. All things in the universe are living entities: animals, plants, forces of nature, topographic features. The Supreme Force (First Maker) designed the universe and the Crow show their respect for these blessings through their daily life (customs, traditions, and practices). First Maker instilled the universe with baxpe or spiritualness. They maintain an intimate personal relationship with all things in the world around them and the spiritualness that they possess. By treating all things in a respectful fashion, the Crow can continue to survive.

The Crow historical perspective sees time as interlinked so that there is an intimate relationship between the individual and the past. The past (tradition or time) provides the template for the appropriate way to live. The Crow live in constant presence with the past that truly transcends the western concept of time. There are five qualities of time; sacred time, ancient Indian time, historic time, the present, and the future, which have some sequential qualities but for the Crow the spiritualness of these times is most important.

In this world perception many landscapes and places are sacred. They are sacred because they represent why and how things are done. Sacred sites include cultural material scatters, petroglyphs, tipi rings, homesteads, burial areas, cairns, communal kills, fasting beds, medicine lodges, rock art, stone rings, and settlements. Sacred locations and places include water (springs and rivers), spirit homes (springs, rivers, hills, and mountains), landscapes (mountains and topographic features), plant and animal procurement areas, fossil areas, and mineral locations.

Geology and Minerals

The reservation contains a varied geology, as does the State of Montana (see earlier Geology and Minerals description). Of particular interest to this EIS are the deposits of subbituminous coal within the reservation. The known coal occurrences in the Powder River Basin are generally located in the Paleocene Fort Union Formation. Coal on the reservation is produced primarily from nine coal beds:

1. Roland: Top of Tongue River Member; average thickness 9 feet; resources 0.3 billion short tons; ranges in calorific value from 7,021 to 9,114 BTU, the sulfur content is 0.2 to 0.7 percent, and ash content 3.8 to 9.7 percent.
2. Smith: Tongue River Member; average thickness 7 feet; resources 0.3 billion short tons; ranges in calorific value from 7,607 to 8,272 BTU, the sulfur content is 0.6 to 1.0 percent, and ash content 6.8 to 30.2 percent.
3. Anderson: Tongue River Member; average thickness 20 feet; resources 1.9 billion short tons; ranges in calorific value from 8,705 to 9,850 BTU, the sulfur content is 0.2 to 0.6 percent, and ash content 2.9 to 6.2 percent.
4. Dietz: Tongue River Member; two coal beds; average thickness 35 feet; resources 5.6 billion short tons; ranges in calorific value from 6,019 to 9,373 BTU, the sulfur content is 0.3 to 0.4 percent, and ash content 2.9 to 6.3 percent.
5. Canyon: Tongue River Member; average thickness 20 feet; resources 3.7 billion short tons; ranges in

calorific value from 8,446 to 9,113 BTU, the sulfur content is 0.2 to 0.3 percent, and ash content 3.2 to 10.7 percent.

6. Wall: Tongue River Member; average thickness 20 feet; resources 4.9 billion short tons; ranges in calorific value from 7,637 to 10,079 BTU, the sulfur content is 0.1 to 1.1 percent, and ash content 3.1 to 12.5 percent.
7. Rosebud: Tongue River Member; average thickness 10 feet; resources 0.1 billion short tons; ranges in calorific value from 7,810 to 9,090 BTU, the sulfur content is 0.5 to 1.1 percent, and ash content 8.1 to 12.6 percent.
8. McKay: Tongue River Member; average thickness 10 feet; resources 0.1 billion short tons.
9. Robison: Tongue River Member; average thickness 10 feet; resources 0.05 billion short tons.

The coals occur on the east side of the reservation in a 12 to 15 mile wide area, extending from the Wyoming border to the north border of the reservation.

These deposits have been estimated to contain 17.1 billion short tons of coal of which 16.1 billion tons may be prospective for CBM development (Crow Tribe 2002). The aggregate thickness of these coals may be as thick as 100 feet in places (Admin. Report BIA-7, 1975). Geology and stratigraphy of the planning area are discussed at length in the Minerals Appendix.

The Absaloka coal mine produces coal from a strip of land the Crow Tribe ceded in 1904 to the U.S. for settlement by non-Indians. The U.S. holds rights to minerals underlying the ceded strip in trust for the tribe. In 1972, with the approval of the Department of the Interior and pursuant to the Indian Mineral Leasing Act of 1938, Westmoreland Resources, Inc., a non-Indian company, entered into a mining lease with the tribe for coal underlying the ceded strip (Supreme Court May 1998). Today the Absaloka mine annually produces an average of 5,500,000 short tons of coal from its 5,400-acre permitted facility.

The reservation also includes the Soap Creek, Lodge Grass, Gray Blanket, Hardin, and Ash Creek oil and gas fields. There have been 172 conventional wells drilled to date on the reservation. Production occurs from the Fort Union, Shannon, Tensleep, Amsden, and Madison formations within the reservation (Crow Tribe 2002).

Protecting the Indian lessors from loss of royalty as a result of conventional oil and gas drainage is a prime responsibility of the BLM. Under the terms of both federal and Indian leases, the lessee has the obligation to protect the leased land from drainage by drilling and producing any well(s) that are necessary to protect the lease from drainage, or in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM document H-3160-2, Drainage Protection Guidelines Instruction Memorandum. Under this memorandum, federal or Indian mineral interests determined to be in danger of drainage will be subject to geologic, engineering, and economic analyses in order to define the presence and magnitude of resource drainage.

Hydrology

Hydrological resources on the reservation consist of surface water flow from several rivers and their associated tributaries, and the production of groundwater from a variety of geological formations. A detailed explanation of the regional hydrology including that of the reservations is included in an earlier section of this chapter under Hydrology.

The Crow Indian Reservation is within that portion of the CBM-emphasis area associated with the Billings RMP area. The three major drainages on the Crow Reservation are the Bighorn River, Little Bighorn River, and Pryor Creek (Crow Tribe 2002). Three additional drainage basins partially headwatered on the reservation are Bighorn Lake (on the Bighorn River), the upper Tongue River, and Rosebud Creek. Collectively, these drainages are part of the Yellowstone River basin (Crow Tribe 2002).

Water quality in the rivers and streams on the reservation is reported to be generally good, with levels of dissolved solids naturally high (Crow Tribe 2002). Pollution problems (primarily high sediment and salinity levels) are primarily related to non-point source agricultural practices and return flows. Table WIL-2 in the Wildlife Appendix summarizes aquatic resources characteristics and resource values from the Montana NRIS (2001) Internet database for several representative drainages on the Crow Reservation, including the upper and lower Bighorn River, the Little Bighorn River, the upper Tongue River, and Rosebud Creek.

According to the 1996 303d list, several watersheds and impaired water bodies are adjacent to the Crow Reservation. These include the Rosebud watershed which crosses a part of the Crow Reservation; The Lower Bighorn watershed includes a large part of the Crow Reservation, which contacts both impaired portions of the Bighorn River; and the Little Bighorn watershed that includes a large part of the Crow Reservation, but no water bodies are determined to be impaired on the 1996 303d list.

Most streams experience an increase in concentrations of dissolved solids downstream because of irrigation return flow, increased base flow contributions, and pollution from human activities. Water contributed as base flow water has been in contact with soil and rocks for long periods of time. It therefore contains larger concentrations of dissolved solids than surface runoff water (Crow Tribe 2002).

Surface water quality in the Little Bighorn River basin is affected by high-quality Big Horn Mountain snowmelt, surface- and ground-water inflow, and irrigation in Montana. As in most semi-arid areas, the concentration of dissolved materials in effluent streams generally increases with distance downstream. The total sediment load is large, ranging between 158 and 16,200 tons/day for the Little Bighorn below Pass Creek. Other than its high suspended sediment concentrations, water in the Little Bighorn River can be characterized as very good water that is suitable for most uses.

Snowmelt, ground- and surface-water inflow, geology, and irrigation affect water quality in the creeks draining into the Tongue River. The chemical quality of these creeks is suitable for most uses, although the high hardness and alkalinity values might require treatment for some industrial uses. Again, water quality in these creeks degrades with increasing distance downstream. Based on an analysis for the referenced document, water in Squirrel Creek failed to meet the Secondary Drinking Water Standards for Total Dissolved Solids. Surface and groundwater inflows as well as evaporation, degrade water quality in Rosebud Creek (Crow Tribe 2002).

The groundwater resources for the reservation are more diverse than to those described for the Powder River Basin in the previous Hydrology section of this chapter. The potential for groundwater resources underlies most of the Crow Reservation. The stratigraphy varies from Pre-Cambrian age granitic gneiss and schist in the Big Horn and Pryor mountains on the west to the Eocene deposits of the Wasatch Formation in the Wolf Mountains and Powder River Basin on the east. The pronounced geologic structures, semi-arid climate, and sculptured terrain lead to highly varied, but often prolific, groundwater resources within the reservation. Regional aquifers located on the reservation include the following:

- Alluvial sand and gravel (Holocene)
- Terrace gravel (Pleistocene)
- Clinker deposits (Holocene, Pleistocene, and Pliocene)
- Fort Union Formation (Paleocene)
- Fox Hills—Hell Creek sandstone (Upper Cretaceous)
- Eagle Sandstone (Upper Cretaceous)
- Parkman Sandstone (Upper Cretaceous)
- Pryor Conglomerate (Lower Cretaceous)
- Tensleep Formation (Pennsylvanian)
- Mission Canyon limestone of the Madison Group (Mississippian)
- Jefferson limestone (Ordovician)

Locally many other water-bearing zones may occur in isolated sandstone and siltstone beds, and in fractured bedrock of any type (Crow Tribe 2002). A total of 2,237 wells have been registered with the MBMG. The majority of the wells are producing at depths less than 200 feet bgs and only 30 wells have been drilled deeper than 700 feet bgs. The majority of the wells are used for stock water, irrigation and domestic consumption (Crow Tribe 2002).

Groundwater quality under the reservation is summarized on Table 3-16.

Land Use and Realty

The Crow Reservation comprises approximately 9 percent of the land in the planning area. Of the approximately 1.5 million acres of tribal or allotted trust ownership, 68 percent is grazing rangeland, 12 percent is dry cropland, 3 percent is irrigated cropland, 1 percent is forested, 1 percent is wildland, and 1 percent is developed area (Crow Tribe 2002). The Crow maintain almost 1.2 million acres of leased grazing lands, 150,000 acres leased dry-farming land, and the nearly 30,000 acres leased irrigated farming land. Most lands are leased to large non-Indian interests by Allottees (U.S. Department of Commerce 1996).

TABLE 3-16
GROUNDWATER SODIUM ABSORPTION RATIO AND TOTAL DISSOLVED SOLIDS VALUES
CROW INDIAN RESERVATION

Study Area	Formation	# Wells	Avg. SAR	SAR Range	Avg. TDS	TDS Range
Hardin 3 (NE)	Fort Union	22/2	4.7/43	55 – 0.4		
		36			1,794	405 – 4,672
	Quaternary	16	4.36	32 – 0.1	1,487	184 – 3,920
	Judith River	1		0.7		405
Hardin 4 (NW)	Quaternary	15	7.3	15 – 1	2,859	6,570 – 724
	Unknown	9	9	47 – 0.1	2,223	4,770 – 606
	Pre Judith River	2		0.5 – 0.4		3,170 – 2790
Hardin 5 (SW)	Quaternary	6	4	7 – 2	2,871	806 – 5,850
	Unknown	1		12		614
	Pre Judith River	2		52 – 0.4		4,990 – 2,065
Hardin 6 (SE)	Quaternary	14	1.9	11 – 0.7	1,318	7,720 – 400
	Judith River	3	54	64 – 47	1,107	1180 – 1,000
	Pre Judith River	3	50	82 - 23	3,126	8,060 – 452

Miller et al. 1977
SAR is sodium absorption ratio
TDS is total dissolved solids
Avg. is average
(Crow Tribe 2002)

The principal communities located on the Crow Reservation are as follows:

- Crow Agency—The Crow Tribal Government administration, the BIA, and the Crow Hospital are located in the town of Crow Agency. There are approximately 3,245 Indian people residing in Crow Agency. A 16-bed hospital is located in Hardin, Montana, approximately 12 miles from Crow Agency. Two larger hospitals (250+ bed facilities) are located in Billings, Montana, 65 miles from Crow Agency. Billings is recognized as the major medical referral center for east-central Montana and northern Wyoming.

- Lodge Grass—The Lodge Grass is located approximately 22 miles south of Crow Agency and houses the Lodge Grass Health Center. Approximately 2,125 Indian people live in Lodge Grass.

- Pryor—The Pryor Health Station is located here, approximately 69 miles northwest of Crow Agency. The Indian population of Pryor is estimated at 1,018.

- Wyola—This community is located approximately 13 miles from Lodge Grass and approximately 35 miles from Crow Agency. There are nearly 450 Indian people residing in Wyola.

Paleontological Resources

The Crow Reservation includes bedrock deposited during the Late Cretaceous to Early Tertiary time. These geologic formations were deposited in a broad, epicontinental seaway that extended through the western interior from the Arctic Ocean to the Gulf of Mexico during Late Cretaceous. The cyclic transgression and regression of the shallow seas and the final withdrawal during the Late Tertiary time resulted in a wide variety of environments of deposition. The depositional environments of marine and nonmarine sedimentation resulted in a rich fossil record including dinosaurs, mammals, and other vertebrate and paleobotanical remains. The great abundance, diversity, and generally excellent fossil preservation in the region present significant scientific research opportunities.

Detailed paleontological field surveys have not been conducted within the reservation. The formations listed below are known to yield paleontological material across Montana:

- Wasatch—has yielded mammals and plant fossils
- Fort Union—various non-marine animals and plants
- Fox Hills-Hell Creek—marine and non-marine animals including dinosaurs
- Bearpaw, Judith River, Claggett—marine animals and dinosaurs
- Morrison—dinosaurs and early mammals
- Swift and Rierdon—marine invertebrates
- Madison—marine invertebrates

Site-specific studies would need to be conducted prior to bedrock disturbance (Crow Tribe 2002).

Recreation

The Crow Indian Reservation is a large contiguous tract of land that provides dispersed outdoor recreation for tribal members. This includes hunting, fishing, picnicking, camping, hiking, horseback riding, snowmobiling, and off-road vehicle use. Yellowtail Dam at Big Horn Canyon provides some of the finest fishing, water sports and camping in the State of Montana. Non-tribal members are not allowed to hunt on the reservation except for spouses of tribal members. Crow Agency recreational facilities are provided at three city parks, the school gymnasium, playground areas, and the Crow Tribal Fairgrounds. Within the town of Lodge Grass on the reservation, there is a city park with landscaped open space and picnic facilities. Outdoor sports and playground equipment are available on the school grounds in Lodge Grass.

The Crow Tribe hosts one of the largest powwows held in the U.S., The Crow Fair, it takes place at the Crow Agency every August. There is spirited competition dancing, drumming, and singing, as well as food and craft concessions. Crow Agency is also near the Battle of the Little Big Horn National Monument, a popular tourist site. Once each year the tribe does a brilliant re-enactment of the battle.

Soils

Soils in the reservation, just like soils in the surrounding area, are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams. For more information on soil types, see the Soils Appendix.

Vegetation

The major native plant communities on Crow Lands include grass and shrub rangelands, forestlands, riparian areas, and barren lands. These classifications are discussed in detail in the Vegetation section.

Rangelands on the reservations are mostly mixed grass prairie in the lowlands and mixed grass, ponderosa pine (*Pinus ponderosa*), Rocky Mountain juniper (*Juniperus scopulorum*), and Douglas fir (*Pseudostuga menziesii*) in foothill and mountain areas (Crow Tribe et al. 1997). Predominant rangeland species are bluebunch wheatgrass (*Pseudoroegneria/Agropyron spicata*), western wheatgrass (*Agropyron smithii*), Idaho fescue (*Festuca idahoensis*), green needlegrass (*Stipa viridula*), needle and thread (*Stipa comata*), little bluestem (*Schizachyrium scoparium*), blue grama (*Bouteloua gracilis*), and sideoats grama (*B. curtipendula*). Other species of grass such as switchgrass (*Panicum virgatum*), Indian ricegrass (*Oryzopsis hymenoides*), big bluestem (*Andropogon gerardii*), prairie sandreed (*Calamovilfa longifolia*), and little bluestem are found on sandy sites.

Riparian species include prairie cordgrass, rushes, and sedges. Forbs include lupine (*Lupinus* spp.), Hood's phlox (*Phlox hoodi*), green sagewort (*Artemisia campestris*), cudweed sagewort (*Artemisia ludoviciana*), fringed sagewort (*Artemisia frigida*), white loco (*Oxytropis lambertii*), povertyweed (*Monolepis* sp.), and scurf pea (*Psoralea tenuiflora*). Shrubs include big sagebrush (*Artemisia tridentata*), rabbitbrush (*Chysothamnus* spp.), snowberry (*Symphoricarpus albus*), greasewood (*Sarcobatus vermiculatus*), and snakeweed (*Gutierrezia sarothrae*) (Crow Tribe 2002).

Forestlands on tribal lands are mainly in the higher elevations in the Wolf Mountains, Bighorn Mountains, and Pryor Mountains. Ponderosa pine is the dominant tree with aspen (*Populus tremuloides*) stands also present in some drainages.

Riparian zones are the smallest land cover type on the Crow Reservation (Crow Tribe et al. 1997). Dominant vegetation in these linear strands along rivers and streams are cottonwood (*Populus* spp.), boxelder (*Acer* *negundo*), green ash (*Fraxinus pennsylvania*), sandbar willow (*Salix interior*), and American plum (*Prunus americana*). These areas can also have a thick understory of shrubs, if livestock access to them is limited.

Special Status Species

Four plant species of special concern to the State of Montana that occur on tribal lands are sweetwater milkvetch (*Astragalus areetioides*), Joe Pye weed (*Eupatorium maculatum* var. *bruneri*), Purpus' sullivantia (*Sullivantia hapemanii* var. *hapemanii*), and tall centaury (*Centaurium exaltatum*). See the Vegetation Appendix Table VEG-6 for habitat information for these species.

There are certain other plant species that are sacred to the Crow Nation for traditional and/or therapeutic reasons. These special status plants are in addition to those listed under the Vegetation section for the total project area.

Noxious weeds are similar on the Crow Reservation to the rest of the project area and are discussed under the main Vegetation section in this EIS.

Wildlife

According to the Crow Indian Reservation Natural, Socio-Economic and Cultural Resources Assessment and Conditions Report there are an estimated 79 species of mammals, 260 species of birds, five species of amphibians, and 14 species of reptiles found on the Crow Reservation some time during the year. Big game species include pronghorn antelope, elk, white-tailed deer, buffalo and black bear. Small game animals include white-tailed jackrabbit, snowshoe hare, and mountain cottontail. Upland game birds include Merriam's turkey, mourning dove, blue grouse, ruffled grouse, sharp-tailed grouse, sage grouse, chukar partridge, ring-necked pheasant, and gray partridge.

Fur bearers on the reservation include: beaver, muskrat, lynx, bobcat, raccoon, red fox, coyote, badger, striped skunk, western spotted skunk, mink, ermine and long tailed weasel. Many species of rodents are found on the reservation, of these the prairie dog is the most important because of it's relationship as prey.

Several raptorial birds are common throughout the area and nest on the reservation. Some of these include the American kestrel, marsh hawk, red-tailed hawk, bald eagle, and golden eagle. Prairie falcons may also reside on the reservation but are considered uncommon.

Special Status Species

Five endangered species may at times be found on the reservation (Crow Tribe of Indians 2002). These are the grizzly bear, gray wolf, black-footed ferret, whooping crane and peregrine falcon. It is unlikely that any of the endangered mammals reside on the reservation. Whooping cranes and peregrine falcons may migrate through the Crow Reservation in the spring and fall months.

Aquatic Resources

The Crow Tribe (2002) reported that 19 species of fish occur on the Crow Reservation at some time during the year. The tribe also stated that Bighorn Lake (impounded by Yellowtail Dam), which begins in Wyoming and runs into the Crow Reservation in Montana, provides some of the finest fishing in the State. The tribe noted that a nationally famous fishery for huge rainbow trout and brown trout occurs in a 12-mile reach of the Bighorn River downstream of Yellowtail Dam.

Water discharged from Bighorn Lake to the river is cool and nutrient-rich, and supports a blue-ribbon trout fishery reported to be the premier tail-water fishery in North America (Crow Tribe 2002). Table WIL-3 (in the Wildlife Appendix) summarizes fish species composition and abundance information from the Montana State Library Natural Resource Information System (Montana NRIS 2001) Internet data base for the same representative drainages on the Crow Reservation that were listed in the preceding paragraph for Table WIL-2 (in the Wildlife Appendix). In addition to these drainages, Pryor Creek in the western portion of the Crow Reservation provides some habitat for rainbow, yellowstone cutthroat, and brook trout and is rated as having a moderate fisheries resource value (Montana NRIS 2001).

Northern Cheyenne Reservation

Much of the information in this section was summarized from The Northern Cheyenne Tribe and Its Reservation: A Report to the U.S. Bureau of Land Management and the State of Montana Department of Natural Resources and Conservation (Northern Cheyenne Tribe April 2002). Readers should refer to that document for more detailed information. This document can be downloaded from MDEQ CBM web page at http://www.deq.state.mt.us/CoalBedMethane/index.asp.

The Northern Cheyenne Indian Reservation occupies about 445,000 acres in eastern Big Horn and southern Rosebud counties, Montana. U.S. Highway 212 provides access. The reservation covers nearly 695 square miles and is bordered on the east by the Tongue River and on the west by the Crow Reservation. According to the BIA Realty Office, the tribe has 442,193 trust acres and 444,000 of surface and mineral estate lands. There are 138,211 individual allotted acres on the reservation.

President Arthur issued an Executive Order establishing the reservation in November of 1884 with a land trust of about 271,000 acres. In 1900, President McKinley issued a second Executive Order on behalf of the Northern Cheyenne that shifted the eastern boundary to the Tongue River, expanding the reservation to its current size. The topography deviates from low, grass-covered hills to high, steep outcroppings and narrow valleys. Elevations range from approximately 3,000 to 5,000 feet.

Tribal Government

The tribe ratified a constitution and bylaws in 1936 according to Indian Reorganization Act rules. The Tribal Constitution was amended in 1960 and 1996. The 1996 amendment initiated a three branch system: Executive Branch, consisting of the Tribal President, Vice President, Secretary and Treasurer; Legislative Branch consisting of the Tribal Council and it committees, and Judicial Branch consisting of the courts. The Tribal Council consists of 11 full-time members, a seat held by the Vice President, five seats each representing one of the districts (Ashland, Birney, Busby, Muddy, and Lame Deer), and five seats allocated among the five districts based on the percentage of Tribal membership. The Tribal President presides over the Tribal Council. The Tribal Council powers include representative, proprietary, fiscal, police, and economic.

In the Executive Branch, the Tribal President and Vice President are elected by the Tribal membership and the Tribal Council appoints the Secretary and Treasurer. The Tribal President oversees the Executive Branch and appoints persons to all Tribal Boards, commissions, departments, and agencies (Culture Committee, Economic Development Committee, Enrollment Committee, Gaming Commission, Land Committee, St. Labre Task Force, Newsletter Committee, Grazing Board, Natural Resource Board, Housing Authority, Utilities Commission, TERO Commission, Board of Health, Ad Hoc Committee, and Credit Committee) and oversees a host of tribal programs.

The reservation court system was updated in 1998 providing for the election of at least two full-time trained court judges and at least three part-time appellate judges appointed by the Tribal President. A Constitutional Court was established to review the constitutionality of Tribal Council ordinances and has the exclusive power to remove a Tribal judge.

Demographics

According to the 2000 Census, the population of the Northern Cheyenne Reservation (reservation) is 4,470 persons, of whom 4,029 are Native Americans. The Northern Cheyenne Tribe report indicates that this number likely underestimates the actual population. Although the Census does not provide estimates of undercounts, the report estimates the actual reservation population could be about 5,000, based on past Census adjustment methods. Tribal enrollment is 8,008 persons, of whom 4,343 live on or near the reservation.

Geographically, the Northern Cheyenne Reservation's most immediate social environment consists of Bighorn and Rosebud counties, the Crow Reservation on the west, and Powder River County to the east. The reservation has a much higher population density than the surrounding counties. According to the 2000 Census, the reservation had 6.4 persons per square mile, several times greater than the surrounding counties, which had 1.4 persons per square mile. The age distribution on the reservation is more heavily weighted toward the young than the surrounding counties. The median age on the reservation is 22.7 years compared to an average of 39.2 years in the three surrounding counties.

According to the 1990 Census, the poverty rate on the reservation was 47 percent. This compares to an average poverty rate of 12 percent for the non-reservation portions of Rosebud and Powder River counties. Additional information on poverty rates, including rates calculated by the BIA, is provided in the Socioeconomics section of Chapter 3.

Social Organization

There is a housing shortage on the reservation. The Northern Cheyenne Report estimates that there are about 1,200 housing units on the reservation to serve a population of about 5,000. As a result, most reservation housing is overcrowded and a number of tribal members commute from off-reservation housing to jobs on the reservation. Of the 1,200 housing units, about 800 are public housing managed by the Northern Cheyenne Housing Authority, about 20 units are employer-owned housing, and about 300 units are privately owned. In addition, there is an unknown number of mobile homes and trailers. Overall, the housing on the reservation is in poor condition, due to a number of factors including age, poor construction, and lack of financial resources to maintain it. A significant number of the housing units do not have regular electrical service.

The tribe operates two programs intended to address the housing situation on the reservation—the Northern Cheyenne Housing Authority, which is responsible for new public housing construction and renovation projects, and the Housing Improvement Program, which provides funding for the renovation of private homes on the reservation.

The report provides a detailed description of public services and facilities, including utilities, education, social services, police, fire and medical services, employment and job training, and transportation. A common theme with a number of the services is their inadequacy due to maintenance or capacity issues. A number of basic programs and services on the reservation are still administered by the federal government. The BIA is directly responsible for providing law enforcement services and also manages the reservation's forests and range lands. The BIA is responsible for the reservation's road network and oversees all real estate transactions.

Public schools are available for pre-school grades, and K-12 in Lame Deer. Ashland houses the St. Labre Indian High School or students may decide to attend public high school in Colstrip, Montana. In Colstrip there are three public elementary schools, a middle school, and a transportation system, which serves all grade levels. For college, students may choose to attend the Dull Knife Community College in Lame Deer. The institution offers several associate degrees and certified programs. Dull Knife Community College also offers courses on the Cheyenne language. Approximately 62 percent of the tribal members have a high school diploma and 5.6 percent have a Bachelor's Degree or higher.

Economics

The current economy is primarily based on livestock; individual tribal members own an estimated 12 to 15 thousand head of cattle, which are presently worth about $12 million on the open market. The tribe has approximately 27,000 acres of reservation lands presently under cultivation, the vast majority of which is dryland farming. This primarily entails hay, wheat, barley, and small grains. Annual revenues generated by farming are estimated at about $2.5 million (U.S. Department of Commerce 1996).

In addition to this agricultural-based income, the tribe has developed several secondary routes of income including construction, timber sales, small business, light manufacturing and casino gaming.

There are several skilled construction contractors and subcontractors amongst the tribe, one of which is reported to have a contract for construction of the new Community Center (the old one having burned down in 1989). Additionally, new tribal housing units are planned; tribally based contractors are bidding for this project. In general, the construction industry generates sizable employment and revenues for the tribe.

One third of the reservation or approximately 147,000 acres is composed of forested land, the majority of which is comprised of Ponderosa Pine forests. The commercially available portion of the these forested lands is estimated at 70 percent. The Northern Cheyenne Pine Company is the lead forest product company using reservation timber resources.

There are currently 44 small businesses on the reservation, the majority Indian-owned. These businesses include laundromats, restaurants, gas stations, grocery stores, construction contractors, drilling companies, a lumber mill, a clothing designer, and Indian arts and crafts outlets. The reservation also hosts several light manufacturing facilities.

Recently the tribe opened the Northern Cheyenne Bingo facility, a moderate-sized casino operation, offering bingo, pull tabs, and video poker. Although new, it generates nearly $11,000 a week in revenues and employs a number of tribal members.

Additional Detail

The information that follows was summarized from a report by the Northern Cheyenne Tribe (April 2002). Readers should refer to that document for more detailed information.

According to the 1999 BIA Labor Force Report, only 29 percent of the potential 2,437-person labor force on the reservation is employed; the unemployment rate is 71 percent. For further discussion, see Table 3-15 and the text in the Social and Economic Values section under the heading of Unemployment.

A detailed discussion of the history of reservation employment and economics in relation to energy production is provided in the Northern Cheyenne report. The report reviews the energy development between 1970 and 1990 and the associated rise and then fall of wages, employment, and property taxes in the reservation area. The primary local economic impact of the mineral development during that time was in the creation of jobs and payment of wages, in addition to state and local taxes collected on mineral extraction. Energy and extraction provided some of the highest-paying jobs available in Montana.

Despite the new wealth and jobs created, the energy boom from 1970 to 1990 generally did not support improved prosperity on the reservation. On the reservation, a number of indicators of economic health declined during this period. Reasons cited for this deterioration of economic conditions include lack of access by Northern Cheyenne to the high-paid energy jobs, limited local commercial infrastructure on the reservation, and lack of access to the energy-related revenues to support public services and infrastructure on the reservation.

The federal government plays a major role in tribal economics. Direct federal funding in the form of grants, contracts, and funding agreements and indirect costs recovery make up the lion's share of the tribe's total revenues and expenditures. Between 1976 and 1997, the Northern Cheyenne Tribe entered into contracts with the BIA assuming responsibility for more than 20 BIA programs with a total budget in fiscal year 2002 of $3.7 million. The tribe also enters into funding agreements with the Indian Health Service, and federal housing, welfare, and employment programs. In all, the tribe administers about 70 federal grants and programs with a combined value in fiscal year 2002 of about $21.3 million. In fiscal year 2002, federal funding for direct and indirect program expenditures is projected to exceed the tribe's general fund revenues by a factor of 10.

Sources of tribal government fiscal resources include the general fund, indirect cost reimbursement, fiduciary funds, and special revenue funds. The general fund is used to finance the basic operations of tribal government. The fund is also used to provide matching funds for federal programs and to subsidize under-funded federal programs. General fund revenues are derived from income from tribal natural resources (primarily timber sales and grazing leases), earnings distributed from the permanent fund, interest on other funds, and federal payments in lieu of taxes. Because the reservation tax base is limited, the tribe imposes no taxes and derives no revenues from taxation. The general fund budget for fiscal year 2002 is $2.03 million, which represents a 40 percent decline from 2001, primarily due to decreased earnings distribution from the permanent fund and declining income from natural resources. Tribal discretionary funds—those funds available to fund the operations of the tribal government and discretionary programs and services—are limited.

Air Quality

The air quality and climate of the Northern Cheyenne Reservation is similar to that of the regions described earlier in Chapter 3. The Northern Cheyenne Reservation is classified as a PSD Class I area. Additionally, the community of Lame Deer, Montana, is classified as a moderate PM_{10} nonattainment area.

The tribe is under contract with Pennsylvania Power and Light to maintain, calibrate, and report data from three ambient air PSD stations. These stations are used to monitor SO_2, NO_2, wind speed and direction, precipitation, barometric pressure, solar radiation, temperature and dew point. Background data from two of these stations for the January 1999 through June 2000 period indicate the maximum hourly concentration for SO_2 was 0.021 ppm and for NO_2, 0.034 ppm. However, the annual averages remain very close to zero.

Particulate matter (PM_{10} and PM2.5) ambient air monitoring is conducted in the community of Lame Deer. No exceedances of the NAAQS were noted in the years 1999 to 2000. Daily PM_{10} values ranged from 1.6 ug/m3 to 131.3 ug/m3. The PM_{10}, 24-hour average "not to exceed" value is 150 ug/m3.

The tribe is in the process of developing a Tribal Implementation Plan, which will allow for enforcement of Class I air quality standards.

The reservation is located in a part of Montana that has a moderate climate relative to its latitude. Snow rarely accrues for long periods of time because of the warm Chinook winds, which originate from the mountains in the West. This portion of Montana is also known for its "Indian Summers" which frequently extend into November. The mean annual temperature is 45.5°F with a summer high of 110°F and a winter low of -48°F. The bulk of the reservation varies from 12 to 18 inches annual precipitation, depending on the elevation.

Culture and History

The Cheyenne are believed to descend from the Algonquian language people in the Great Lakes region, what the Northern Cheyenne call the northern homelands (Notum'histah'o'omih'nah). Western scientists believe that during the 1400s and 1500s they migrated southward into the Missouri River and the Black Hills country. The Northern Cheyenne believe that they left the Great Lakes region about 1600 to avoid contact with encroaching Europeans. They farmed corn and squash and practiced subsistence fishing and gathering and hunting small game. While in the Missouri River region they encountered a group of Suhtio and they later integrated their beliefs, traditions, and customs into one culture.

After 1600 they adopted the horse and became reliant on large game hunting and following the buffalo herds. From around 1640 to 1830, the Cheyenne engaged in commerce with Europeans as part of the fur trade, encountering the Lewis and Clark expedition about 1804.

The first treaty with the U.S. government was signed by a small group of Cheyenne in 1825 (the Friendship Treaty). In the 1830s, the Cheyenne began to split into the Southern Cheyenne and the Northern Cheyenne, preferring to live close to their Lakota relatives in the Black Hills, Powder River, Yellowstone River, and Tongue River regions.

European settlement, gold seekers, and other Euroamerican activity increased in the region throughout the first half of the 1800s leading to increased conflict, between Native People and with Euroamericans. In an attempt to decrease conflict the U.S. government established military outposts and an Indian Agency in the Upper Platte River Valley. They convinced a number of Native nations to adopt the Fort Laramie Treaty of 1851, which assigned the Cheyenne and Arapaho to lands south of the North Platte River and north of the Arkansas River in present day Wyoming, Nebraska, Colorado, and Kansas. However, some Cheyenne bands remained north of the South Platte River and became known as the Northern Cheyenne. The Northern Cheyenne continued to resist incursions into what they considered their territory. Tensions between Euroamericans and the Northern Cheyenne increased during the Civil War. The Colorado Volunteer Militia raided a peaceful Cheyenne Village culminating in the Sand Creek Massacre. From this point through the late 1870s, the Cheyenne were at war with the U.S. government. The Battle of the Little Bighorn is the most well-known incident of this long struggle.

There were many bands involved in these battles and struggles and their movements were complicated and read like any war story. The Cheyenne were eventually subdued and split into various groups. In 1881, all of the Northern Cheyenne were sent to Fort Keogh and were allowed, under the Indian Homestead Act of 1875, to move south near the Tongue River and along Rosebud and Muddy creeks. The Northern Cheyenne settled in the area practicing their traditional culture and making a livelihood practicing western farming and ranching.

Disputes arose between white ranchers and the Northern Cheyenne leading to a special investigation, the outcome of which was the establishment of the Northern Cheyenne Reservation in 1884. Disagreements over the reservation boundaries continued until 1900 when the current reservation boundaries were established.

The Northern Cheyenne are the people of The Morning Star. They are caretakers of the Sacred Buffalo Hat, a sacred covenant with *Maheo* (Creator). Life for the Northern Cheyenne is a holistic interrelationship of history, work, religion, language, sacred belongings, health, medicine, and education. All of these work to maintain the environment and culture of the people. Their sacred ways, such as the Keeper of the Sacred Buffalo Hat Covenant greeting the grandfather morning star, maintain a connection to *Maheo* and the creative essence that caused the universe and life itself to exist. Ritual and diligence in daily life to follow tradition maintains the elemental arrangement of creation. In this arrangement, all elements of creation are like a family: Sun as Grandfather, Earth as Grandmother, Moon as Mother, Stars as Brothers and Sisters, and to the four cardinal directions as the Sacred Spirit Helpers who watch over their way of life.

An excellent outline and illustration of the Cheyenne cosmology and interrelationships can be found in the report, The "Northern Cheyenne Tribe" and its Reservation (2002), which illustrates the universe as a renewable cycle with spiritual essence in constant interaction. *Maheo*, spiritual essence, is contrasted with *Heestoz*, substance or matter. Both are necessary for the continuation of the universe. Maleness, associated with *Maheo*, is the highest point in the universe and femaleness, associated with *Heestoz*, is the lowest point. The interaction of *Maheo*, Sun (Creator) and *Heh'voom*, earth (Grandmother) bring about all life. Between *Maheo* and *Heh'voom* are layers of space creating the structure of the universe is between. These layers are the Blue-Sky Space, the Nearer-Sky Space, the Atmosphere, the Earth Surface Dome, and the Deep Earth. With this cosmology, birds and mountains are special sacred animals and places since they are closer to Blue-Sky Space containing the manifestation of *Maheo* (sun, moon, etc.). All things in this cosmology are animate.

Through sacred ways and ceremony, the Cheyenne believe that they can harness the spiritual essence as a power to benefit physical existence. If they do not practice traditional culture and beliefs to maintain the balance and cycle, the spiritual essence will not be available to benefit them or maintain the earth system.

With these belief systems natural resources become culturally and spiritually important, particularly water (with living spirits), plants (considered to be relatives), animals (also relatives), great birds (messengers to the spirits in Blue-Sky Space), and fossil and mineral sources (used in ceremony). Cultural resources such as burials, ceremonial sites (fasting locations, vision quest sites, sweet lodges, and memorials), homes (tipi rings, historic depressions, foundations, and cabins), community and commercial reservation-era sites, military and exploration-related sites, and prehistoric sites (lithic scatters, cairns, and petroglyphs) are considered sacred to the Northern Cheyenne.

Geology and Minerals

The reservation contains a varied geology, as does the State of Montana (see earlier Geology and Minerals description). Of particular interest are the deposits of subbituminous coal within the reservation. The known coal occurrences in the Powder River Basin are generally located in the Paleocene Fort Union Formation. The coals on the reservation are known to be beneath the entire reservation and are estimated to contain 23 billion tons of coal of which 16.3 billion tons may be prospective for CBM development (Admin Report BIA-3 1975). Five CBM wells have been drilled prior to 1989 on the reservation with modest results (Northern Cheyenne Tribe 2002). In 1991, the tribe drilled and tested two CBM exploratory wells (Northern Cheyenne Tribe 2002). Geology and stratigraphy of the planning area are discussed at length in Chapter 3, Geology and Minerals and in the Minerals Appendix.

The reservation does not have any known oil or gas fields. Twenty conventional wells have been drilled to date. Additionally, Atlantic Richfield (ARCO) has explored for oil and gas reserves on tribal lands but this data has not been released to state or federal agencies.

Non-metallic mineral resources on the reservation include bentonite, building and ornamental stone, claystone and shale, clinker, and gravel (Northern Cheyenne Tribe 2002).

Protecting the Indian lessors from loss of royalty as a result of conventional oil and gas drainage is a prime responsibility of the BLM. Under the terms of both federal and Indian leases, the lessee has the obligation to protect the leased land from drainage by drilling and producing any well(s) that is necessary to protect the lease from drainage, or in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM Handbook H-3160-2, Drainage Protection Guidelines. Federal or Indian mineral interests determined to be in danger of drainage are subject to geologic, engineering, and economic analyses in order to define the presence and magnitude of resource drainage.

Hydrology

Hydrological resources on the reservation consist of surface water flow from the Rosebud Creek and the Tongue River and their associated tributaries, and the production of groundwater from a variety of geological formations.

Surface Water

Surface water on the reservation is contained in the Rosebud and Tongue River watersheds. These two watersheds support natural flows as summarized in Tables 3-17 and 3-18.

These two watersheds contain water resources of variable quality as described in the Water Resources Technical Report (ALL 2001b). Table 3-19 summarizes the long-term average water quality for the Tongue River watershed.

According to the 1996 State of Montana 303d list, several watersheds and impaired water bodies are adjacent to the Northern Cheyenne Reservation. The probable cause of the impairment is nutrients and the probable source is dam construction and hydromodification. The Lower Tongue Watershed intersects with the Northern Cheyenne Reservation, which extends up to the Tongue River itself although the reservation does not touch the impaired Tongue River segment. The Rosebud watershed includes most of the Northern Cheyenne Reservation and a part of the Crow Reservation; the Northern Cheyenne Reservation contacts the impaired portion of the Rosebud Creek.

Groundwater

The groundwater resources of the reservation are similar to those described for the Powder River Basin in the previous Hydrology section of this chapter. Formations of importance to the groundwater resources of the reservation include the Madison Group of Mississippian age; the Fox Hills Sandstone and Hell Creek Formation of Cretaceous age; the Fort Union Formation of Tertiary age, and the valley fill-alluvium of Quaternary age. The geologic formations and associated aquifers are discussed below. (Northern Cheyenne Tribe 2002).

TABLE 3-17
AVERAGE ANNUAL GAGE AND ESTIMATED NATURAL FLOWS FOR THE TONGUE RIVER NEAR THE NORTHERN CHEYENNE RESERVATION
(STUDY PERIOD 1940-1982, HKM 1983)

Location	Flow Type	Acre-Feet/Year
Tongue River at Tongue River Dam	Gage Flow	332,907 (St. Dev. = 112,406)
	Est. Natural Flow	421,238 (St. Dev. = 102,464)
Southern Boundary of Reservation	Est. Natural Flow	439,253 (St. Dev. = 106,154)
Northern Boundary of Reservation	Est. Natural Flow	455,161 (St. Dev. = 103,255)
Tongue River at Brandenburg Bridge	Gage Flow	362,614 (St. Dev. = 152,288)
	Est. Natural Flow	461,019 (St. Dev. = 104,352)

(Northern Cheyenne Tribe 2002)

TABLE 3-18
AVERAGE ESTIMATED NATURAL FLOWS FOR ROSEBUD CREEK, NORTHERN CHEYENNE RESERVATION
(STUDY PERIOD 1939-1981)

Estimated Natural Flow at Location	Acre-Feet/Year
Rosebud Creek at Southern Boundary	11,818 (St. Dev. = 6,417)
Rosebud Creek neat Colstrip, Near Northern Boundary	26,727 (St. Dev. = 14,172)
Rosebud Creek near Mouth, Near Rosebud	27,297 (St. Dev. = 18,439

HKM, RCB Hydrology 1982
(Northern Cheyenne Tribe 2002)

TABLE 3-19
COMPARISON OF PREVIOUSLY CITED WATER-QUALITY PARAMETERS WITH LONG-TERM AVERAGE FIGURES, TONGUE RIVER AT STATE LINE

Data Source	Range	Sulfate (mg/l)	Dissolved Magnesium (mg/l)	EC (uS/cm)	SAR	Boron (µg/l)
HKM (1972)	High	500	50	1,100	2.0	0.38
	Low			230		
USGS (1985-1999 average)	Mo. Average High	180	45	699	0.67[1]	<1
	Mo. Average Low	30	10	299		

[1] SAR = 0.67 reflects published USGS data for water year 1997, as parameter 00931 SAR is not included in data set available on USGS website (Northern Cheyenne Tribe 2002).

Madison Group

The Madison Group is divided into the Lodgepole Limestone at the base, the Mission Canyon Limestone, and the Charles Formation at the top. The Madison Group is estimated to average around 1,100 feet thick within the reservation and the depth to the top is estimated to range between 7,200 and 9,100 feet below land surface. The aquifer contained within the Madison Group reportedly consists of extensive limestone and dolomite with shale, evaporate, and cherty zones. Yields from Madison wells in the area range from 94 gpm immediately NW of the reservation to a reported 2,382 gpm from a flowing well approximately 90 miles NW of the reservation. Better porosity and permeability in the Madison aquifer are mainly associated with oolitic to fragmental limestone and with coarsely crystalline dolomite in the lower part. Solution and collapse breccias occur in the outcrops off the reservation; the extent of these features in the subsurface within the reservation is unknown.

Fox Hills Sandstone

The Fox Hills Sandstone, in the central Powder River Basin east of the reservation, is a sequence of marine and continental sandstone and shale 20 to 200 feet thick. Limited information available from oil and gas test holes on the reservation indicates the thickness of this unit to range from 65 to 760 feet. Depth to the top of the Fox Hills in the reservation is estimated to range between 2,200 and 3,500 feet. The most extensively used aquifer in the Central Powder River Basin is called the Fox Hills-Lower Hell Creek aquifer and it consists of the Fox Hills Sandstone and the overlying lower part of the Hell Creek Formation. Well yields from the Fox Hills-Lower Hell Creek aquifer range from 0.5 to 20 gpm and commonly are about 5 gpm. Yields of as much as 200 gpm to industrial wells have been reported (Slagle et al. 1985).

Hell Creek Formation

The Hell Creek Formation consists of sandstones, interbedded shales, and siltstones. Available data indicates this unit underlies the entire reservation with a thickness of between 600 and 650 feet. Depth to the top of the Hell Creek formation within the reservation is estimated to be greater than 600 feet. Only one well is known to be completed in the Hell Creek formation near the reservation. It was drilled in 1959 for Saint Labre Mission to a total depth of 980 feet. At the time the well was constructed, it was under artesian pressure and flowed at the land surface at a rate of 60 gpm.

Fort Union Formation

The Fort Union Formation consists of the Tullock, Lebo Shale, and Tongue River members. The total thickness of this formation within the reservation is estimated to range from 1,800 to 2,200 feet. The formation dips to the southeast at 1 to 2 degrees regionally.

Tullock Member

The Tullock Member of the Fort Union Formation is estimated to range between 100 and 250 feet thick on the reservation and consists of sandstone, coal, and shale beds. This unit is not a known source of water on the reservation. Yields to wells completed off the reservation in the Tullock Member range from about 0.3 to 40 gpm and generally are about 15 gpm (Slagle et al. 1985).

Lebo Shale Member

The Lebo Shale Member of the Fort Union Formation consists of dark shale and reportedly contains some lignite beds but no coal. The thickness of this unit on the reservation is estimated to range between 100 and 300 feet. It is not a known source of water.

Tongue River Member

The Tongue River Member of the Fort Union Formation is the major source of water withdrawn from wells in the northern Powder River Basin (Slagle 1985). It is the most reliable and shallow aquifer underlying most of the area, including the Northern Cheyenne Reservation. There are more than 100 springs on the Northern Cheyenne Reservation. Many of these springs emanate from the base of a clinker-shale contact, very commonly in the Tongue River Member of the Fort Union Formation. The springs may be quite vulnerable to the effects of regional aquifer drawdown. Depending on the geologic location of the spring, yield can range from 1 to 92 gpm.

Lower Tongue River Aquifer

The Lower Tongue River aquifer consists of the sandstone, siltstone, shale, coal, and clinker beds from the base of the Robinson coal seam to the shale beneath the Knobloch coal seam. The aquifer is generally around 500 feet thick, except in the major stream valleys where erosion has reduced the total thickness to between 300 and 450 feet thick. Drill hole data indicates beds of permeable sandstone and shale are discontinuous and occur primarily as lenses grading from shale to siltstones.

Several wells are known to be completed in the Lower Tongue River aquifer. Most of these domestic wells were completed in sandstone and yield between 8 and 20 gpm. Wells in Muddy Cluster and Busby finished in the sandstone reportedly yield 18 and 50 gpm, respectively.

Upper Tongue River Aquifer

The Tongue River Member is Tertiary in age and crops out at the surface over much of the reservation. The Upper Tongue River aquifer consists of the sandstone and clinker beds within the Knobloch, Wall, and Anderson systems.

Knobloch System. This unit consists of sandstone, siltstone, shale, coal, and clinker. The Knobloch system ranges from 0 to 366 feet in thickness. Depth to the top of the unit is generally less than 1,100 feet depending on location on the reservation. Many wells and springs obtain groundwater from this system. Yields of wells completed in the sandstone generally range between 8 and 10 gpm. Wells completed in the Knobloch clinker yield as much as 50 gpm. Springs associated with sandstone and coal outcrops of the Knobloch generally flow less than 3 gpm.

Wall System. The Wall system consists of sandstone, siltstone, shale, coal, and clinker. It ranges in thickness from 0 to 790 feet. Beds of permeable sandstone are discontinuous and occur primarily as lenses between shale and siltstone layers. Depth to the top of the unit is generally less than 300 feet depending on location on the reservation. The Wall coal seam and its related clinker form the thickest most continuous unit of this system, ranging from 20 to 40 feet. The Canyon coal seam, within the Wall system, also forms a relatively thick and continuous unit (20 to 30 feet). Several wells and springs derive water from the Wall system. Well yield ranges from 10 to 15 gpm. Springs flow from sandstone, siltstone, and clinker units and vary from 1 to 25 gpm within the reservation.

Anderson System. This system consists of fine sandstone, siltstone, shale, coal, and clinker ranging in thickness from 0 to 300 feet. The Anderson coal seam and its related clinker deposits form the thickest single unit within this system. Thickness of the Anderson coal varies from 30 to 60 feet but thins to the west. Massive clinker related to the burning of the Anderson and thin upper coal seams is reported to vary from 100 to 200 feet in the central and northern portions of the reservation.

Several wells and springs are known to derive water from the Anderson aquifer system. No production data is available as all wells completed before 1977 were monitoring wells. Springs associated with sandstone and siltstone units above the Anderson coal seam generally yield less than 1 gpm within the reservation.

Valley Fill-Alluvium

Valley fill-alluvium is found underlying and bordering the principal drainages within the reservation. These deposits include the Rosebud Creek, Muddy Creek, Lame Deer Creek, and Tongue River alluvium.

Rosebud Creek Alluvium

The Rosebud Creek alluvium consists of clay, silt, sand, gravel, and clinker fragments. Silts and clays are usually found as thin beds separating sand and gravel deposits. According to driller's logs, the Rosebud Creek alluvium ranges in thickness from 6 to 110 feet, with an average thickness of 52 feet. An aquifer test performed in 1978 indicated an average transmissivity of 6,243 ft^2/d for a saturated thickness of approximately 76 feet. This value is considered to be representative of the valley fill alluvium immediately adjacent to Rosebud Creek between the southern reservation boundary and Busby. For wells completed in the Rosebud Creek alluvium, yield ranges between 6 and 20 gpm.

Muddy Creek Alluvium

The Muddy Creek alluvium consists of a mixture of silt, sand, gravel, and clinker fragments. Based on driller's logs, the thickness of these deposits range from 0 to 112 feet and average 52 feet thick. The average saturated thickness is 30 feet. Assuming the deposits are similar to the Rosebud Creek alluvium, a transmissivity of 2,463 ft^2/d is calculated. Several wells, known to be completed in the Muddy Creek alluvium, yield between 10 and 15 gpm for domestic supply.

Lame Deer Creek Alluvium

The Lame Deer Creek alluvium consists of silt, sand, and relatively thick gravel and clinker wash as compared to that of Rosebud and Muddy Creek deposits. Driller's logs indicate that the thickness of this deposit ranges from 12 to 63 feet. Domestic wells completed in the Lame Deer Creek alluvium yield between 6 and 15 gpm.

Tongue River Alluvium

The Tongue River alluvium consists of sand and gravel-sized clinker fragments derived from the Tongue River member of the Fort Union formation.

The thickness of this deposit ranges from 34 to 100 feet and averages 66 feet (Northern Cheyenne Tribe 2002).

Groundwater Quality

A thorough evaluation of groundwater quality was performed by the Northern Cheyenne Research Project from 1973 through 1977, and published by HKM in 1983. The following descriptions are based on the data collected during that study period. The majority of water quality data on the reservation exists for the Fort Union and alluvial aquifers. Individual aquifers are discussed below (Northern Cheyenne Tribe 2002).

Fort Union Formation and Tongue River Member

Samples obtained from wells indicated water in these geologic units to be a mixed type with this dominant ions being sodium, magnesium, calcium, bicarbonate, and sulfate. TDS concentration generally range from 232 to 3,774 mg/l in wells tapping sandstone, coal, and clinker units. Water ranges from soft to very hard with calcium carbonate levels between 14 to 1,468 mg/l. Fluoride concentrations range from 0.1 to 9.1 mg/l and sulfate concentrations range from 0 to 2,119 mg/l. Adjusted SAR values for water samples obtained from the sandstone units of the Tongue River member of the Fort Union formation ranged from 0 to 53. Water samples from the coal beds of the Fort Union had adjusted SAR values ranging from 2.6 to 101. Springs contained very hard water with calcium carbonate concentrations between 190 to 950 mg/l. Sulfate and fluoride concentrations ranged from 8.0 to 337 mg/l and 0.27 to 12.0 mg/l, respectively. The adjusted SAR ranged from 0.5 to 50.8.

Groundwater from sandstone and coal aquifers of the Tongue River Member is generally suitable to serve as a drinking water source; however, several samples from wells obtaining water from the coals did exceed the Primary Drinking Water Standards for chromium and fluoride. Water from the Tongue River aquifers is generally quite mineralized and not aesthetically pleasing. This water is generally undesirable for irrigation due to salinity problems; however, it is acceptable for livestock use.

Valley Fill— Alluvium

Water-quality for the valley fill-alluvium on the reservation appears to be a mixed-type, with the dominant ions being calcium, magnesium, sodium, bicarbonate, and sulfate. A range of water-quality values in the alluvial systems is presented in Table 3-20.

Groundwater from the alluvium is generally suitable for drinking water with respect to the Primary Drinking Water Standards, although several samples taken from wells completed in the alluvium of Rosebud, Muddy, Lame Deer creeks, and the Tongue River, equaled or exceeded the Primary Standards for cadmium. One sample from a well completed in the Rosebud Creek alluvium exceeded the limits for chromium and lead. The alluvial groundwater is quite mineralized with concentrations of TDS, sulfate, iron, and manganese that often exceed Secondary Drinking Water Standards. Exceeding secondary standards does not represent a health hazard, but rather makes the water less desirable as a drinking water source for aesthetic reasons. The alluvial groundwater would probably be suitable for

TABLE 3-20
WATER-QUALITY OF THE ALLUVIUM ON THE NORTHERN CHEYENNE RESERVATION

Constituent	Rosebud Creek	Muddy Creek	Lame Deer Creek	Tongue River
TDS (mg/l)	374 - 2,048	1,082 - 1574	558 – 1,144	527 - 3,277
$CaCO_3$ (mg/l)	140 - 1,225	664 - 955	450 - 626	35 - 946
Sulfate (mg/l)	67 - 1,370	313 - 731	119 - 361	0 - 1,893
Nitrate (mg/l)	0 - 4.0	0 - 1.0	1.0 - 4.3	0.1 - 6.2
Fluoride (mg/l)	0 - 1.3	0.5 - 1.5	0.8 - 2.0	0.3 - 6.4
Adjusted SAR	0 - 34	5.2 - 6.0	5.2 – 6.0	4.3 - 51
No. wells tested	17	5 samples	4	12

(Northern Cheyenne Tribe 2002)

irrigation provided tolerant crops were used and special irrigation practices were instituted to prevent salinity and permeability problems. The water is acceptable for livestock use (Northern Cheyenne Tribe 2002).

Water Rights

The water rights of the Northern Cheyenne Tribe are set forth in the Northern Cheyenne-Montana Compact, which represents a statement of the federally reserved water rights held by the tribe. The Reserved Water Rights Compact Commission (RWRCC) of Montana describes Federal Reserved Water Rights as follows:

Federal Reserved Water Right

A federal reserved water right is a right to water that was created when Congress or the President of the U.S. reserved land out of public domain. The U.S. Supreme Court has ruled that enough water be reserved to meet the purposes for which the reserved lands were designated. The date that the land was withdrawn and the reservation created is the priority date of a federal reserved water right. Reserved water rights for Indian reservations, for instance, go back to the 1800s. Federal reserved water rights do not have the same restrictions placed on them as on state appropriative water rights. For example, a notice of appropriation or beneficial use is not required to maintain a federal reserved right, and it is not lost due to non-use. The Tribe's reserved water right addresses three sources of water, the Tongue River, the Bighorn River, and Rosebud Creek. The Compact entitles the Tribe to a priority date of October 1, 1884. This right provides for:

1. The diversion of 1,800 acre-feet per year, or the amount necessary to irrigate 600 acres, from Rosebud Creek.
2. The diversion of 30,000 acre-feet per year from the Bighorn Lake at Yellowtail Dam for any beneficial use.
3. The diversion of 32,500 acre-feet from the Tongue River for any beneficial use.
4. An additional 19,530 acre-feet from Rosebud Creek, for any beneficial use subject to the constraint that diversion and use do not adversely affect other water right holders of priority June 30, 1973, and earlier.
5. The extraction of alluvial groundwater by means of wells of less than 100 gallons per minute pumping capacity, exclusive of other water rights (Northern Cheyenne Tribe 2002).

History of Compact

In 1913, the state court of Montana initiated a proceeding to adjudicate water rights on Tongue River. In this proceeding, the federal government did not fully satisfy the Northern Cheyenne Tribe's *Winters v. U.S.* (207 US564) water rights claims to water in the Tongue River. Instead, the U.S. asserted a claim on behalf of the tribe only for the amount of water used by the Tribe at that time. In the Miles City Decree of 1914 (the Decree), the tribe was awarded only 30 cfs of water out of an available 425 cfs. The Decree established a priority date of 1909 for the Northern Cheyenne water claim: the next to last priority awarded in the Decree. The tribe's water right as set forth in the Decree was insufficient to irrigate the tribe's agricultural lands at the time and the late priority date established a high probability that the tribe would be out of water before the irrigation season began (Northern Cheyenne Tribe 2002).

The tribe has asserted that the failure to pursue the tribe's *Winters v. U.S.* (207 US564) rights claims constituted a breach of the federal trust responsibility. In 1975, the tribe filed an action in U.S. District Court to determine its water rights. The Untied States also filed suit on behalf of the tribe. In 1979, the State of Montana initiated proceedings for a general stream adjudication, which included the claims of the tribe. In that same year, the estate established the Montana Reserved Water Rights Compact Commission to negotiate a water rights settlement with the tribes of Montana. Negotiations with the Tribe began in 1980. Several years of negotiations yielded the Northern Cheyenne-Montana Water Rights Compact (the Compact). The Tribe formally approved the Compact on May 20, 1991, with Tribal Resolution #144. The Compact was ratified by the Montana State Legislature on June 11, 1991, and was re-ratified on December 16, 1993, by the 53rd Legislature Special Session (Northern Cheyenne Tribe 2002).

On September 30, 1992, the federal government ratified the Compact via "The Northern Cheyenne Indian Reserved Water Rights Settlement Act of 1992" (Pub.L. 102-374, 106 Stat. 1186) (Settlement Act). The purposes of the Settlement Act of 1992 are:

> To achieve a fair, equitable, and final settlement of all claims to Federal reserved water rights in the State of Montana of the Northern Cheyenne Tribe and its members and allottees and the U.S. on behalf of the Northern Cheyenne Tribe and its members and allottees. To approve, ratify, and confirm the Water Rights Compact entered into by the Northern Cheyenne Tribe and the State of Montana on June 11, 1991. To direct the Secretary

of the Interior to enter into a cooperative agreement with the State of Montana for the planning, environmental compliance, design, and construction of the Tongue River Dam Project (P.L. 102-374, 106 Stat, 1186, Section 3(8)) in order to: implement the Compact's settlement of the Tribe's reserved water rights claims in the Tongue River Basin, protect existing Tribal contract water rights in the Tongue River Basin: provide [up to as per the Compact] 20,000 acre-feet per year of additional storage water for allocation to the tribe, and allow the State to implement its responsibilities to correct identified Tongue River Dam safety inadequacies. To provide for the conservation and development of fish and wildlife resources in the Tongue River Basin. To provide for the enhancement of fish and wildlife habitat in the Tongue River Basin. To authorize certain modifications to the purposes and operation of the Bighorn Reservoir in order to implement the Compact's settlement of the Tribe's reserved water rights claims. To authorize the Secretary of the Interior to take such other actions as are necessary to implement the Compact.

Northern Cheyenne Tribal Water Policy and Management

Northern Cheyenne Water Code: The Northern Cheyenne Water Code sets the regulatory framework for the management of tribal water resources on the reservation. The purpose of the Water Code is to preserve and protect the quantity and quality of Tribal water resources through wise use, administration, management, and enforcement. This includes, but is not limited to, permitting and prioritizing tribal water use, long-term planning to ensure the sustainability of resources, encouraging conservation practices, and protecting traditional, religious and cultural uses of water (Northern Cheyenne Tribe 2002).

- Tribal Water Resources Board and Administrator: The administration of the Water Code will be the responsibility of a Tribal Water Administrator (TWA) and a Tribal Water Resources Board (Water Board). The Tribal Water Board is responsible for adopting new rules and regulations, approving or disapproving permits, reporting to the Tribal Council on relevant water-related issues, declaring critical management areas and water supply conditions, establishing and maintaining a technical staff to administer and enforce the Code, and developing recommendations for long-term funding sources to support tribal water management.
- The TWA: The TWA issues citations and initiates enforcement proceedings for violations of the Code. The TWA administers water rights, monitors and enforces water use through inspections, responds to emergency situations, collects data and researches development possibilities, and conducts educational programs. Recommendations are made to the Water Board on critical management areas and methods for improving water use and efficiency. The TWA develops and submits an annual budget and report to the Water Board.
- Water Management: The Water Code sets forth the primary physical, hydrologic, and engineering principles guiding the management of surface and groundwater resources on the reservation. These procedures are required to effectively manage, fully utilize, and protect the water rights of the Northern Cheyenne Tribe, and to assure compliance with applicable laws and requirements of the Northern Cheyenne Montana Compact of 1991 and the Northern Cheyenne Water Rights Settlement Act of 1992. The Water Board will adopt a Comprehensive Water Management Plan at least every 5 years to guide water resource decisions, permitting, and management. Surface water and groundwater is evaluated, and no later than March 1 of each year, the condition of these resources is declared. Water allocation procedures for both surface and groundwater are outlined in this section for use during drought conditions.
- Permitting: A water permit is required to divert or undertake any activity affecting or involving tribal water. This includes water diversions, discharge, injection, transfers, surface water alterations, groundwater recharge, storage impoundments, or hydropower generation. The Code clearly identifies the application process outlining the procedures, hearings, and resolution of water disputes. The Water Board will preside over all hearings. The Tribal Court will enforce subpoenas issued by the Water Board.
- Enforcement: Prohibited acts and penalties are clearly outlined in the Water Code. Any person who commits prohibited acts shall be subject to civil proceedings before the Water Board on citation by the Tribal Water Administrator. All decisions of the Water Board shall be appealable directly and exclusively to the Tribal Courts.
- Summary: The Northern Cheyenne Water Code contains the provisions and guidelines to effectively manage the water resources of the reservation, however, with the fairly recent

approval of the Water Code, the Tribal Water Resources Board has not yet been established. Currently, no permitting process or accounting for water resources exists on the reservation. Once underway, the Water Code will empower the Tribe by enabling them to control and protect the water resources on the reservation.

- Northern Cheyenne Tribe Draft Surface Water Quality Standards: A water quality standard defines the water quality goals for a water body, or portion thereof, by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by protecting water quality through antidegradation provisions. The Tribe has adopted these standards to protect public health and welfare, enhance the quality of water, and serve the purposes of the Federal Clean Water Act. Currently, the Northern Cheyenne Tribe's Draft Surface Water Quality Standards have been submitted to the EPA and the public review process is near completion. In addition, the Tribe's application under Section 518 of the Clean Water Act for Treatment as a State for the purposes of implementing the Clean Water Act's water quality standards program is still pending before the EPA. The Tribe's Treatment as a State application and water quality standards are vital in the Tribe's water quality protection program and aid in evaluating potential impacts on water quality from a broad range of causes and sources.

- A primary purpose of the water quality standards is to guide efforts to monitor and assess surface water quality within the reservation. Any regulatory pollution controls established by the Tribe or the Federal Government must be developed to ensure a level of water quality that will satisfy these water quality standards. Surface water quality standards are adopted to establish maximum allowable levels or concentrations of pollutants and provide a basis for protecting water quality that is presently better than standards required for surface water quality. They serve to establish a basis for limiting the introduction of pollutants, which could affect existing or designated uses of reservation surface waters. The following surface water characteristics and policies are described in the Draft Water Quality Standards:

- Beneficial Uses: Beneficial use classifications are designated to all surface waters of the reservation in order to achieve national "fishable and swimmable" goals. Narrative water quality criteria and sampling methods are described along with the tribe's biological and radiological surface water standards.

- Antidegradation Policy: The tribe's antidegradation policy is consistent with the federal antidegradation policy found in EPA's water quality standards regulation. The purpose of the policy is to protect existing water quality where the quality of the water is better than required to support the designated uses.

- Mixing Zone and Dilution Policy: The mixing zone and dilution policy describes how dilution and mixing of point source discharges within receiving waters will be addressed in developing discharge limitations for point source discharges. Compliance requirements and 401 Certification procedures are also described. The requirements for standards implementation are outlined. Once approved and adopted by EPA, the Tribe's standards program will have the same legal standing as those adopted by states. The federal government will be responsible for the enforcement of the standards. EPA Region VIII will have the responsibility of enforcing requirements applicable to point source discharges, including those permit requirements that are based on the Tribe's water quality standards.

- SAR and EC. The Tribe is especially concerned about salinity and its impacts on riparian areas and irrigated lands. The Tribe has developed numeric criteria for the Sodium Adsorption Ratio (SAR) and Electrical Conductivity (EC) of waters of the reservation to address these concerns. The proposed numeric standards for EC and SAR are presented in Table 3-21. The rationale behind the numeric criteria for SAR is based on James Bauder's final report, "Recommended In-Stream Standards, Thresholds, and Criteria for Irrigation or Water Spreading to Soils of Alluvial Channels, Ephemeral Streams, Floodplains, and Potentially Irrigable Parcels of Land within the Boundaries of the Northern Cheyenne Reservation" (2001).

In response and consideration of comments, concerns, and objections received from various parties, modifications have been incorporated into the proposed surface water standards for EC and SAR of the Northern Cheyenne Reservation.

Table 3-21 shows revised numeric standards for EC and SAR and indicator values for TDS applicable to the mainstems of the Tongue River and Rosebud Creek and their tributaries.

TABLE 3-21
REVISED NUMERIC STANDARDS FOR EC AND SAR AND TDS INDICATOR VALUES

	Electrical[1] Conductivity (EC) dS/m	**Sodium[2] Adsorption Ratio (SAR)**	**Total[3] Dissolved Solids (TDS) mg/l**
Southern Boundary			
Irrigation period average[4]	1.0	--	660
Non-irrigation period average[5]	2.0	2.0	1,320
Northern Boundary			
Irrigation period average	1.5	--	990
Non-irrigation period average	2.0	3.0	1,320
Tributaries			
Irrigation period average	1.5	--	990
Non-irrigation period average	2.0	3.0	1,320

[1] The EC values are numerical water quality standards. EC is an expression of salinity as electrical conductance reported in deciSiemens per meter at 25 degrees C (dS/m) or in units of millimhos per centimeter (mmho/cm).

[2] The SAR values are numerical water quality standards. SAR is an expression of the concentration of sodium relative to the sum of concentrations of calcium and magnesium in water.

[3] The TDS values are indicator values and are not water quality standards. TDS is an expression of salinity as total dissolved solids in mg/L. The TDS values will be used to monitor conditions and trends in Tribal waters. If a TDS indicator value is exceeded, the tribe will evaluate the cause and, where appropriate, make necessary adjustments to the EC water quality standard(s). Any change to the EC standard will be made through the tribe's water quality standards-setting process.

[4] An irrigation period average is a 30-day average applicable during the period of active irrigation or water spreading, defined by the tribe as April 1 through November 15 annually.

[5] A non-irrigation period average is a 30-day average applicable during the non-irrigation season, November 16 through March 31 annually (Northern Cheyenne Tribe 2002).

Land Use and Realty

The Northern Cheyenne Reservation comprises approximately 2 percent of the land in the planning area. The Northern Cheyenne lands are used for cattle production, mining, logging and lumber production, residential, and recreation (Madison 2001). About 27,000 acres of reservation lands are presently under cultivation; the vast majority of this is dry-land farming, an additional 105,000 acres is composed of forested land that is considered commercially harvestable (U.S. Dept. of Commerce 1996).

The principal communities located on the Northern Cheyenne Reservation are as follows:

- Lame Deer—Lame Deer is located in Rosebud County approximately 21 miles west of Ashland between Busby and Custer National Forest along Highway 212/39. Lame Deer is the tribal headquarters and home of the Northern Cheyenne Powwow. There are approximately 1,925 Indian people residing in Lame Deer.
- Ashland—Ashland is located in Rosebud County 70 miles south of Miles City between Birney and Brandenburg along Highway 212 on the banks of the Tongue River near the Custer National Forest. Approximately 500 Indian people live in Ashland.

Recreation

The North Cheyenne Reservation also provides dispersed outdoor recreation activities for tribal members. Activities include hunting, fishing, hiking, horseback riding, and plant and berry gathering. Unrestricted hunting is limited to tribal members.

Developed recreation sites include Crazy Head Springs and Lost Leg Lake (fishing, camping, picnicking); Green Leaf, Red Nose, Parker, and LaFerre ponds (fishing); and Morning Star Lookout. Undeveloped sites include Buffalo Jump and Badger Peak.

Camping facilities exist at the Northern Cheyenne Craft Center in Lame Deer and at the Morning Star View Campgrounds. Tribal buffalo herds are pastured near Lame Deer Ice Well Campgrounds. A museum/curio shop is under development; this will serve, in part, as an outlet for the work of numerous tribal artists and craftspeople. The tribe holds a 4th of July powwow each year, which is widely attended. Finally, many visitors on their way to Glacier and Yellowstone parks, the Little Big Horn Battlefield, and other regional attractions find it convenient to stop by the reservation.

The only developed recreation area on the North Cheyenne Reservation is Crazy Head Springs. Picnic and camping facilities are available at the springs, which is used heavily. There are also several parks on the reservation including Birney Park, White Moon Park, Tongue River Park, Busby Park, and Lame Deer Park.

The North Cheyenne Reservation has lost recreational facilities in recent years with the closure of a swimming pool at Lame Deer Park and the loss of other park facilities with the opening of a new health center. A public gym was also removed to make room for a tribal government center.

Soils

Soils in the reservation, just like soils in the surrounding RMP area, are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams. For more information on soil types, see the Soils Appendix.

Vegetation

The same types of vegetative communities as described in this chapter are anticipated to be found on the reservation. It is understood that the Northern Cheyenne Tribe considers certain plants to be sacred for their medicinal or traditional values.

The major native plant communities on Northern Cheyenne Lands include grass and shrub rangelands, forestlands, and riparian areas. These classifications are similar to those for the project area as a whole. These classifications are discussed in detail in the Vegetation section. Approximately 391,852 acres are classified as rangelands and 147,319 are classified as forestlands (Northern Cheyenne Tribe 2002). There are approximately 20,000 acres of riparian wetlands on Northern Cheyenne lands. Dominant species for these community types can be found under the Crow Reservation Vegetation section.

Special Status Species

The Northern Cheyenne have many sacred plants that are used for ceremonial and traditional uses. There are at least 170 plants with documented traditional or cultural uses (Northern Cheyenne Tribe 2002).

Wildlife

Wildlife habitat types and species occurring on the Cheyenne Reservation are also generally the same as those described for the CBM study area. Population estimates are not available because of a lack of population survey data. However, the limited available data suggest that big game populations are far below what the habitat can support (Northern Cheyenne Tribe 2002). Mule and white-tailed deer populations have declined recently because of year-round hunting. As in other dry Western areas, riparian areas are the single most important wildlife habitat for many species. The riparian communities and mixed terrain of the Tongue River breaks have been identified as especially valuable wildlife habitat.

Sage grouse are widely distributed in suitable habitat. However, their numbers have declined on the reservation over the last 20 years. Black-tailed prairie dogs, black-footed ferrets, swift fox, mountain plovers, bald eagles, and peregrine falcon are species of concern found on the Northern Cheyenne Reservation (Northern Cheyenne Tribe 2002). With the exception of swift fox, these species of concern are considered under the Wildlife: Special Status Species section for the total project area. Swift fox (*Vulpes velox*) are one of the smallest foxes in the world and are only found in the Great Plains of North America. They were removed as a Candidate Species for Threatened Status by the USFWS on January 8, 2001. Their numbers are believed to be stable, but there is still concern for their future. They prefer short to mid-grass prairies, but they also sometimes inhabit mixed agricultural land (Egoscue 1979; Uresk and Sharps 1986).

The Northern Cheyenne Reservation is within that portion of the CBM-emphasis area associated with the Powder River RMP area. The Northern Cheyenne Tribe (2002) stated that the major streams of concern on the Northern Cheyenne Reservation are the Tongue River and Rosebud Creek. The Tribe reported that Rosebud Creek could support a game fish population if there were an assured flow and temperature control. The Tribe noted that Rosebud Creek is not suited for trout, but that it could support smallmouth bass—a species that prefers cool-water streams with clean bottoms and extensive riffles. Table WIL-2 summarizes aquatic resources characteristics and resource values from the Montana NRIS (2001) Internet data base for the upper Tongue River and Rosebud Creek.

The Northern Cheyenne Tribe (2002) reported there is a diversity of aquatic resources on the Northern Cheyenne Reservation, including some 32 different fish species. The Tribe, citing fisheries studies conducted in the vicinity of the reservation in 1973 (HKM 1973), stated that a reproducing population of smallmouth bass had been established in the Tongue River. Other important species of sport fish that were collected in the Tongue River include walleye, sauger, northern pike, and channel catfish. The Tribe also noted that the Tongue River is unique in supporting the only population of rock bass in Montana. Table WIL-3 in the Wildlife Appendix summarizes fish species composition and abundance information from the Montana NRIS (2001) Internet data base for the upper Tongue River and Rosebud Creek.

Paleontological Resources

Paleontologic resources consist of fossil-bearing rock formations containing information that can be interpreted to provide a further understanding about Montana's past. Fossil-bearing rock units underlie the entire planning area. While fossils are relatively rare in most rock layers, there are seven geologic rock units within the planning area that do contain significant fossil material. Rock units that are known to contain fossils are the Tullock and Ludlow Members of the Fort Union Formation, the Judith River, Hell Creek, Morrison, and Cloverly Formations, the Lakota Sandstone Formation, and the White River Group. Figure 3-1 is a stratigraphic section showing the age and relative position of each of these fossil-bearing units.

The Morrison, Hell Creek, Cloverly, and Lakota Sandstone formations are noted for the occurrence of dinosaur fossils. The Bridger Fossil ACEC, a 575-acre site located in Carbon County within the Billings RMP area, contains outcrops of both the Cretaceous Period Cloverly Formation and the Jurassic Period Morrison Formation. Outcrops of the Morrison Formation within the Bridger Fossil area have yielded the fossil remains of numerous juvenile and subadult sauropods. The Bridger Fossil Area is one of two listed National Natural Landmarks within the Billings RMP area, the other is the Cloverly Formation site in Bighorn County (Federal Register 48(41):8693 1983). There are other areas within the EIS study areas that have been nominated for National Natural Landmarks for paleontological resources.

The Judith River Formation preserves the fossil record from ancient environments including shallow oceans, deltas, rivers, freshwater swamps, and lakes. The Judith River Formation contains the fossil remains of plants as well as many animal species including mollusks, fish, amphibians, lizards, small mammals, dinosaurs, and other reptiles.

The Cretaceous Period Hell Creek Formation preserves the fossil record of a subtropical to tropical environment that was characterized by low plains interrupted by broad swampy bottoms and deltaic areas. Fossil remains from the Hell Creek Formation include a wide variety of plants, mollusks, fish, amphibians, reptiles, birds, small mammals, and dinosaurs. Fossil dinosaur remains include *Triceratops, Anatosaurus,* and *Tyrannosaurus.* The fossil record of plant and animal communities found within the Hell Creek Formation varies between low moist areas and the drier, upland plains environments that were present in the past. The Castle Butte ACEC, located in Yellowstone County within the Billings RMP area, contains outcrops of the Hell Creek Formation, which are noted for their paleontologic resources.

The contact between the Cretaceous Period Hell Creek Formation and the Paleocene Tullock/Ludlow Member of the Fort Union Formation marks an important event in time. This contact represents a time of worldwide extinction for many animals, most notably the dinosaurs, and the beginning of the rapid evolution of mammals. The fossil record from the Fort Union Formation contains evidence of ancient environments that include streamside swamps, bottomlands, and well-established river courses. Fill within ancient river channels contains fossils of fresh water clams and snails. The Tullock/Ludlow Member is the primary fossil-bearing unit of the Fort Union Formation and contains fossils of turtles, fish, reptiles, and mammals.

The Tertiary Period White River Group is considered an important source of fossil mammals. Although the White River Group outcrops in the planning areas, the majority of the fossil-bearing areas are in the Dakotas.

Recreation

Montana's natural features, coupled with the large amount of state and federal lands, offer residents and vacationers a variety of year-round recreational opportunities. Montana has thousands of miles of streams, hundreds of lakes, reservoirs, mountainous areas, rolling hills, and grassland prairies—many of which are available for recreational purposes.

The planning area, which includes the Billings and Powder River RMP areas and the counties of Blaine, Gallatin, and Park, are replete with recreational opportunities that vary with seasonal changes. Spring and summer provide opportunities for fishing, hiking, photography, wildlife viewing, spring turkey hunting, water sports (powered and non-powered), off-road vehicle activities, camping, picnicking, touring (vehicle and bicycle), and caving. Early to late fall is hunting season. Winter brings the winter sports of skiing, snowshoeing, and snowmobiling. The planning area provides vast areas for people to enjoy.

Federal

There are three national forests in the planning area: Custer, Gallatin, and Lewis and Clark. These forests provide a variety of yearlong, outdoor recreation. The Absaroka Beartooth Wilderness and the Lee Metcalf Wilderness (Spanish Peak Unit) in the Gallatin National Forest provide unique wilderness opportunities for hiking, horseback riding, camping, fishing, hunting, wildlife viewing, and photography. The Bridger Mountains National Recreational Trail (also in the Gallatin Forest), the Lewis and Clark Historic Trail, and the Nez Perce National Historic Trail provide opportunities for hiking, photography, wildlife viewing, and historic touring.

The Upper Missouri National Wild and Scenic River and the Missouri Breaks National Monument (North Side–Blaine County) provides fishing, hiking, non-powered water sports, camping, picnicking, wildlife viewing, and photography opportunities.

The Bighorn Canyon National Recreation Area is a popular area for camping, fishing, boating, hiking, wildlife viewing, and photography. West of and adjacent to the Bighorn Canyon National Recreation Area is the Pryor Mountain Wild Horse Range where off-road vehicles are not allowed, and skiing, caving, hiking, and wildlife viewing occur.

The BLM has land holdings throughout the state. The majority of this land is not contiguous; it is fragmented and many times isolated by private holdings. Most of this land is managed for multiple use. Recreational opportunities include hiking, horseback riding, off-road vehicle travel, fishing, hunting, wildlife viewing, camping, picnicking, caving, skiing, and showshoeing. The off-road vehicle plan is currently under protest. If approved, off-road vehicle use would be limited. Included in this land are the Pryor Mountain Wild Horse Range and the Pompey's Pillar National Monument.

There are nine National Wildlife Refuges in the planning area—two in Blaine County, one in Golden Valley County, four in Musselshell County, and two in Stillwater County. They provide opportunities for wildlife viewing, hiking, and photography.

According to 33 CFR Part 329, navigable waters of the U.S. are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the water body, and is not extinguished by later actions or events that impede or destroy navigable capacity. A determination whether a water body in the project area is a navigable water of the U.S. is made by the U.S. Army Corps of Engineers Omaha District's Division Engineer, and is based on a report of findings prepared at the district level in accordance with the criteria set out in regulations. Tabulated lists of final determinations of navigability are maintained in the District office, and are updated as necessitated by court decisions, jurisdictional inquiries, or other changed conditions.

State

There are 12 state parks within the emphasis area that offer outdoor activities, Native American history and geological sites, wildlife preserves, water sports, photography, hiking, camping, and fishing. These parks are Chief Plenty Coups, Cooney Reservoir, Greycliff Prairie Dog Town, Lake Elmo, Madison Buffalo Jump, Medicine Rocks, Missouri Headwaters, Natural Bridge, Pictograph Cave, Rosebud Battlefield, and Tongue River Reservoir.

In addition, state-owned lands checkerboard the planning areas. Much of this land is surrounded by private or federal land. Recreational opportunities include hunting, fishing, wildlife viewing, hiking, snowmobiling, and skiing. Navigable waterways and islands owned by the state also provide additional recreational opportunities.

Local/City Recreation

The larger municipalities of Billings, Bozeman, Laurel, Miles City, Livingston, and Three Forks offer museums, parks, baseball fields, rodeo grounds/fairgrounds, walking/hiking/bike trails, water sports, and other opportunities. The other municipalities in the planning area offer a city park, outdoor sports activities at the schools, and, depending on the municipality, possibly a museum or rodeo grounds.

Private Lands

In addition to public lands, recreational opportunities also exist on privately owned lands, including private campgrounds, resorts, and dude ranches. Activities such as hunting and backcountry trips also may be permitted on privately owned land with landowner consent. Recreational opportunities also arise on private lands as a result of Montana Fish, Wildlife, and Parks (MFWP) actions, such as hunting opportunities through the block management program and conservation easements.

Typical rig used to drill a CBM well

Social and Economic Values

This section examines social, economic and environmental justice information for the 16 counties in the CBM emphasis area. The three counties with the most potential CBM wells are Big Horn, Powder River and Rosebud counties. These counties are located adjacent to each other in southeastern Montana (see Map 1-1). The Northern Cheyenne Reservation is located predominantly in Big Horn County. Information on these reservations is located in this section as well as the sections entitled **Indian Trust Assets** and **Native Americans** in this chapter.

Demographics

Population data for Montana and the 16-county CBM emphasis area is presented in Table 3-22. Between 1990 and 2000, the population in Montana increased at an average annual rate of 1.2 percent to 902,195 persons. The 16-county planning area grew at a slightly greater rate of 1.5 percent over the same period. Three counties—Gallatin, Stillwater, and Carbon—grew faster than the average for the planning area, with average annual rates of 3.0 percent, 2.3 percent, and 1.7 percent, respectively. Four counties—Carter, Powder River, Rosebud, and Treasure—had negative growth rates and lost population.

TABLE 3-22
HISTORICAL POPULATION AND POPULATION FORECASTS

	1990 (Census)	2000 (Census)	Percent Annual Average Growth 1990-2000	2020 (Forecast)	Percent Average Annual Growth 2000-2020
Big Horn County	11,337	12,671	1.1%	14,880	1.6%
Blaine County	6,728	7,009	0.4%	7,310	0.4%
Carbon County	8,080	9,552	1.7%	11,390	1.8%
Carter County	1,503	1,360	-1.0%	1,470	0.8%
Custer County	11,697	11,696	0.0%	13,060	1.1%
Gallatin County	50,463	67,831	3.0%	82,460	2.0%
Golden Valley County	912	1,042	1.3%	1,180	1.3%
Musselshell County	4,106	4,497	0.9%	5,390	1.8%
Park County	14,484	15,694	0.8%	20,170	2.5%
Powder River County	2,090	1,858	-1.2%	1,770	-0.5%
Rosebud County	10,505	9,383	-1.1%	13,720	3.9%
Stillwater County	6,536	8,195	2.3%	10,590	2.6%
Sweetgrass County	3,154	3,609	1.4%	3,870	0.7%
Treasure County	874	861	-0.1%	800	-0.7%
Wheatland County	2,246	2,259	0.1%	2,330	0.3%
Yellowstone County	113,419	129,352	1.3%	158,310	2.0%
Total Emphasis Area	**248,134**	**286,869**	**1.5%**	**348,700**	**2.0%**
State of Montana	**799,065**	**902,195**	**1.2%**	**1,082,260**	**1.8%**

Source: Montana Department of Commerce, 2001. Census and Economic Information Center. Projections by NPA Data Services, Inc.

The forecasted population for the year 2020 is also shown in Table 3-22. For both the state and the CBM emphasis area, the forecasts show faster growth over the next 20 years compared to the last 10 years. State population is forecast to grow by 1.8 percent and the planning area is forecast to grow by 2.0 percent. Four counties—Gallatin, Park, Rosebud, and Stillwater—are projected to grow at equal or greater rates than the average for the emphasis area, with rates of 2.0 percent, 2.5 percent, 3.9 percent, and 2.6 percent, respectively. Population in Treasure County is forecast to fall, with a rate of –0.7 percent. However, personal communication with the Montana Department of Labor and Industry indicates that the projected population of 13,720 for Rosebud County in the year 2020 is an overestimate and that a more likely future population is 12,200 or 12,500 (Montana Department of Labor and Industry 2001b). These numbers correspond to annual growth rates of 1.3 percent and 1.4 percent, respectively, which are more consistent with the average for the emphasis area and the state.

Data on race and ethnicity from the 2000 U.S. Census are shown in Table 3-23. The data indicate that the Montana population is 90.6 percent white, similar to the 16-county planning area, which is 90.1 percent white. Statewide and in the planning area, Native Americans make up the largest non-white group, totaling 6.2 percent and 6.6 percent, respectively. Persons identified as Hispanic or Latino (of any race) compose 2.0 percent of the state population and 2.6 percent of the 16-county area population.

While 13 of the 16 counties are between 92.8 percent and 99.1 percent white, three of the counties—Big Horn, Blaine, and Rosebud—include Indian reservations with substantial Native American populations. Big Horn County, which includes most of the Crow Reservation and part of the Northern Cheyenne Reservation, has a population that is 59.7 percent Native American. Rosebud County also includes part of the Northern Cheyenne Reservation and is 32.4 percent Native American. Blaine County includes most of the Fort Belknap Reservation and is 45.4 percent Native American.

TABLE 3-23
RACE/ETHNICITY AS PERCENT OF TOTAL POPULATION

Geographic Area	Total Population	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent Some Other Race	Two or More Races	Percent Hispanic or Latino (of any race)[1]
Big Horn County	12,671	36.6%	0.0%	59.7%	0.2%	0.0%	0.7%	2.8%	3.7%
Blaine County	7,009	52.6%	0.2%	45.4%	0.1%	0.0%	0.2%	1.5%	1.0%
Carbon County	9,552	97.1%	0.3%	0.7%	0.4%	0.0%	0.6%	1.0%	1.8%
Carter County	1,360	98.6%	0.1%	0.4%	0.1%	0.0%	0.3%	0.5%	0.6%
Custer County	11,696	97.0%	0.1%	1.3%	0.3%	0.1%	0.3%	1.0%	1.5%
Gallatin County	67,831	96.2%	0.2%	0.9%	0.9%	0.1%	0.5%	1.2%	1.5%
Golden Valley County	1,042	99.1%	0.0%	0.6%	0.1%	0.0%	0.0%	0.2%	1.2%

TABLE 3-23
RACE/ETHNICITY AS PERCENT OF TOTAL POPULATION

Geographic Area	Total Population	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent Some Other Race	Two or More Races	Percent Hispanic or Latino (of any race)[1]
Musselshell County	4,497	96.9%	0.1%	1.3%	0.2%	0.0%	0.4%	1.2%	1.6%
Park County	15,694	96.6%	0.4%	0.9%	0.4%	0.0%	0.5%	1.2%	1.8%
Powder River County	1,858	97.4%	0.0%	1.8%	0.1%	0.0%	0.2%	0.5%	0.6%
Rosebud County	9,383	64.4%	0.2%	32.4%	0.3%	0.0%	0.7%	2.0%	2.3%
Stillwater County	8,195	96.8%	0.1%	0.7%	0.2%	0.0%	0.9%	1.2%	2.0%
Sweet Grass County	3,609	97.0%	0.1%	0.6%	0.3%	0.0%	0.7%	1.3%	1.5%
Treasure County	861	96.4%	0.1%	1.6%	0.3%	0.0%	0.9%	0.6%	1.5%
Wheatland County	2,259	97.0%	0.1%	0.6%	0.2%	0.2%	0.3%	1.6%	1.1%
Yellowstone County	129,352	92.8%	0.4%	3.1%	0.5%	0.0%	1.3%	1.9%	3.7%
Planning Area Total	286,869	90.1%	0.3%	6.6%	0.5%	0.0%	0.9%	1.6%	2.6%
MONTANA	902,195	90.6%	0.3%	6.2%	0.5%	0.1%	0.6%	1.7%	2.0%

Source: U.S. Census Bureau, Census 2001a Redistricting Data (Public Law 94-171) Summary File, Matrices PL1 and PL2.
[1]Percent numbers in this column are a subset of one or more of the other race/ethnicity designation percentages.

Table 3-24 shows the percentage of people below the poverty level (as defined by the U.S. Census Bureau) for Montana and each of the 16 study-area counties (1997 data). The Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is poor. Compared to the state as a whole, the 16-county planning area has a somewhat greater percentage of people below the poverty level; some counties within the planning area have poverty rates that are much higher than average for the state.

In 1997, the percentage of the population of Montana below the U.S. Census Bureau poverty threshold was 15.5 percent; the average in the 16-county emphasis area was 17.3 percent. Nine of the 16 counties in the planning area have poverty rates greater than the state average. The two counties with the highest rate are Big Horn and Blaine, where more than one quarter of the population had an income below the poverty level in 1997. The total number of persons in the planning area below the poverty level was about 39,093. This represents about 28.8 percent of the state's total population below the poverty level.

Table 3-14 in the Native Americans section of Chapter 3 shows the percent of tribal members who are employed but below U.S. Health and Human Services poverty guidelines (similar to U.S. Census guidelines). These data indicate that the percent of tribal members who are employed but below the poverty guideline is greater than the total percent of persons below poverty for the respective counties where the tribes are located. It can be inferred that the total poverty rate for all tribal members (employed and unemployed) would be even greater than just for those who are employed, suggesting relatively large numbers of persons on the reservations living in poverty.

The three counties with the most potential CBM wells, Big Horn, Powder River and Rosebud counties, have a combined 2000 population of 24,000, which is less than 10% of the total population of the emphasis area. Two of these counties, Powder River and Rosebud, lost population during the previous decade (both lost 11%), while Big Horn County grew 12% during the same time period. Big Horn and Rosebud counties are forecasted to grow 17% and 30%, respectively, between the years of 2000 and 2020. Powder River County, with its population of 1,858, is projected to continue to slowly lose population between 2000 and 2020. The county seats are in Hardin in Big Horn County with a 2000 population of 3,384, Broadus in Powder River County with a 2000 population of 451, and Forsyth in Rosebud County with a 2000 population of 1,944. There are numerous small reservation communities located in Big Horn and Rosebud counties. In 1990, Big Horn County, which includes most of the Crow Reservation and part of the Northern Cheyenne Reservation, had a population that was nearly 60% Native American. Rosebud County, which includes most of the Northern Cheyenne Reservation had a 2000 population that was 32% Native American. The 1997 poverty rates for Big Horn, Powder River and Rosebud counties were 29.6%, 15.3% and 19.9%, respectively. These rates reflect the relatively large numbers of persons on the reservations living in poverty. For additional information on demographics for the Northern Cheyenne and Crow Tribes see Social and Economic Values in the Native Americans section of this Chapter.

TABLE 3-24
POVERTY STATUS BY COUNTY (AS DEFINED BY U.S. CENSUS BUREAU) (1997)

	Number of Persons Below Poverty Level	Percent of Population Below Poverty
Big Horn County	3,768	29.6%
Blaine County	1,904	26.8%
Carbon County	1,230	12.9%
Carter County	294	19.3%
Custer County	2,022	17.0%
Gallatin County	7,059	11.6%
Golden Valley County	216	21.2%
Musselshell County	893	19.4%
Park County	2,196	13.8%
Powder River County	277	15.3%
Rosebud County	1,999	19.9%
Stillwater County	860	10.6%
Sweetgrass County	418	12.3%
Treasure County	141	15.8%
Wheatland County	453	19.8%
Yellowstone County	15,363	12.1%
Planning Area Total	**39,093**	**17.3%**
Montana	**135,691**	**15.5%**

Source: U.S. Census Bureau Small Area Income and Poverty Estimates Program 2001b.

Social Organization

Housing Units and Vacancy

Housing units and vacancy rates for Montana and the 16-county planning area are shown in Table 3-25. The latest available county-specific data on housing units is from the 2000 Census (U.S. Census Bureau 2001). Although the vacancy rates reported here illustrate the averages in the counties in the planning area, sub-county variations may exist as a result of factors such as high population growth in a portion of the county.

In 2000, Montana had 412,633 housing units, 12,635 or 31 percent of these were in the 16-county planning area. Eight percent (9,874) of the planning area housing units were located in Big Horn, Rosebud and Powder River counties.

Homeowner vacancy rates indicate the percent of total owner-occupied housing that is vacant. In Montana, the homeowner vacancy rate for 2000 was 2.2 percent, compared to 3.4 percent for the planning area. Four counties had home ownership vacancy rates higher than the planning area average, suggesting a surplus of vacant houses on the market. The three counties with the most potential for CBM wells, Big Horn, Powder River and Rosebud, all had lower homeowner vacancy rates than the planning area average. Housing availability on the Northern Cheyenne and Crow Reservations is discussed under Social Organization in the Native Americans section of this chapter.

The rental vacancy rate in 2000 was 7.6 percent for the state and 9.0 percent for the planning area. Generally, rental vacancy rates between 5 percent and 10 percent are considered adequate. Rental vacancy rates below 5 percent can indicate potential rental shortages and above 10 percent can indicate potential surplus. The rental vacancy rates for the three counties with the most potential for CBM wells, Big Horn, Powder River and Rosebud, were 6.3, 13.1 and 11.7, respectively.

Temporary Housing

Temporary housing units are typically defined to include hotels and motels, and recreational vehicle or camping sites. An inventory of temporary housing units is typically included in an environmental impacts analysis to use in determining potential impacts on the local housing supply from an influx of temporary population (such as construction workers or other employees). This data is typically gathered for a city, county, or small region. Because of the broad scope of this study, however, an inventory of accommodations by specific location was not attempted. A large number of hotels/motels and recreational vehicle and camping areas are available throughout the state and the 16-county planning area. These sites tend to be concentrated in and around the large cities, such as Billings or Bozeman, as well as major tourist or recreation areas, such as Yellowstone National Park. They are less likely to be available in the three counties with the most potential for CBM wells.

Public Services and Utilities

Public services, typically provided by local governments (cities, counties, and special service districts), include police and fire protection, emergency medical services, schools, public housing, parks and recreation facilities, water supply, sewage and solid waste disposal, libraries, and roads and other transportation infrastructure. Other important community services include electric and communications utilities. The provision of public services and the ability of service providers to adapt to change over time, or resulting from specific development activities, depend on a number of factors, including financial ability and community leadership. Public services are generally funded by tax revenues, although there may be other sources of revenue such as user fees or utility franchise fees. The tax base of the county or community where public services are provided is often a key component of the funding of public services. Information on public services and facilities for the Northern Cheyenne and Crow Reservations is presented under Social Organization in the Native American section of this chapter.

TABLE 3-25
HOUSING UNITS

	2000 Housing Units	2000 Homeowner Vacancy Rate (%)	2000 Rental Vacancy Rate (%)
Big Horn County	4,655	2.2	6.3
Blaine County	2,947	2.7	7.6
Carbon County	5,494	3.0	8.1
Carter County	811	6.9	8.1
Custer County	5,360	2.6	11.6
Gallatin County	29,489	1.8	5.7
Golden Valley County	450	6.3	8.8
Musselshell County	2,317	6.8	8.4
Park County	8,247	2.3	7.4
Powder River County	1,007	3.0	13.1
Rosebud County	3,912	1.9	11.7
Stillwater County	3,947	2.7	6.1
Sweetgrass County	1,860	2.1	10.3
Treasure County	422	2.3	6.4
Wheatland County	1,154	6.4	18.2
Yellowstone County	54,563	1.2	5.4
Planning Area Total	**126,635**	**3.4%**	**9.0%**
Montana	**412,633**	**2.2%**	**7.6%**

Source: U.S. Census Bureau 2001

Attitudes, Beliefs, Lifestyles, and Values

Information on general attitudes, beliefs, lifestyles, and values in Montana and the general planning area as they relate to CBM development has been gathered from public comment letters received during the scoping process for this project and also from past summaries in several related documents. While the generalized characterizations are not likely to apply to all individuals, the intention is to provide an idea of the range of the attitudes and lifestyles of the population subgroups present in the study area. See the Socioeconomics Appendix for detailed information.

The study area population is largely rural, with strong ties to the land and to the many small towns. Residents generally value the rural character of their lifestyle. Specific aspects of this lifestyle might include appreciation of wide-open spaces, natural landscape, fresh air, and solitude. The lifestyle of rural communities often offers the desirable qualities of neighbors knowing each other, lack of urban problems, relaxed pace, personal freedom, and being a good place to raise children. Longtime residents often want to see continued control of the land at the local level without interference from outside agencies or groups.

A portion of the population in the study area are Native Americans, who generally desire to preserve many elements of their heritage, express strong connections with the natural environment, and often do not wish to become homogenized into the non-Indian culture. At the same time, some tribal members or subgroups are pursuing the development of energy resources for the long-term social and economic betterment of tribal members.

A small but growing population is made up of professionals, craftspeople, retirees, and others who have moved to small towns to enjoy the slower pace of life and various amenities. While the forested areas of western Montana tend to attract more of this group than eastern Montana, these people are present in the study area as well. They may participate in opposition to development proposals that appear to jeopardize the quality of their new lifestyles.

Areas where energy resources are developed often see the influx of people from other areas. Many of these people regard their employment as temporary, expect to move on to other areas, and do not play an integral part in community affairs. Long-term local residents often resent these “outsiders” while at the same time realizing some economic benefits from the business and service demands of these newcomers.

The vast majority of public comments received during the scoping process in early 2001 relayed concerns about potential impacts on water quality and quantity. Those who commented were most concerned with the discharge of water of poor quality (e.g., saline) and the drawdown of groundwater aquifers. Other concerns include possible increases in traffic levels, noise, visual resource impacts, and psychological stress associated with change to the surrounding built and natural environment.

The comments reflect a difference in attitudes toward CBM development among those individuals and organizations that might profit directly from CBM and those that would not. The comments reflect a tension between the desire for new development to support the often stagnant rural economies and the concern that such development could harm the environment and the lifestyle qualities for which Montana is known, including natural beauty, wide-open spaces, and solitude. Concerns were also expressed about potential adverse affects on the lifestyles of Native Americans, particularly those on the reservations. The comments reflect the traditional high value placed on natural resources by these groups, the importance of existing water and other natural resources in tribal economies and cultures, and the opinion that tribal members will be unduly burdened with the costs of development while not receiving many or any benefits.

Economics

Employment

Table 3-26 displays state employment by sector for the years 1990 and 1998. In 1998, an estimated 543,333 people were employed in Montana, with 184,525 in the 16-county planning area. In 1998, employment in the planning area represented about 34 percent of the jobs in the state. Between 1990 and 1998, total employment in the state grew by 106,759, an increase of 24.5 percent. Employment in the 16 study-area counties grew by a total of 39,008, or 26.8 percent, during the same period.

Montana’s largest employment sectors in 1998 were services, retail trade, and government; the smallest sector was mining. By far the fastest-growing sector between 1990 and 1998 was construction, which increased by 74.3 percent during the period. Other fast-growing sectors were agriculture, forestry and fishing services, and retail trade.

Some sectors of state employment decreased between 1990 and 1998. Mining jobs decreased by 14 percent in the state, from 7,824 to 6,730. Overall, government jobs increased by only 3.4 percent; within that sector, military jobs decreased by 19.4 percent and federal civilian jobs decreased by 8.2 percent.

Tables 3-27 and 3-28 present state and planning area employment by sector. Table 3-27 shows that the economic base of the planning area by sector is very similar to the state as a whole. However, as indicated in Table 3-28, there is substantial variation among the sizes and strengths of the various economic sectors in the 16 study-area counties.

TABLE 3-26
MONTANA EMPLOYMENT TRENDS BY SECTOR

	1990	1998	Change, 1990-1998	Percentage Point Change, 1990-1998
Farm Employment	30,576	32,071	1,495	4.9%
Non-Farm Employment				
Agriculture, Forestry, Fishing, and other	6,154	8,739	2,585	42.0%
Mining	7,824	6,730	-1,094	-14.0%
Construction	19,070	33,245	14,175	74.3%
Manufacturing	26,342	29,504	3,162	12.0%
Transportation and Public Utilities	23,858	26,759	2,901	12.2%
Wholesale Trade	17,449	20,693	3,244	18.6%
Retail Trade	78,715	106,202	27,487	34.9%
Finance, Insurance, and Real Estate	27,693	34,673	6,980	25.2%
Services	118,623	161,740	43,117	36.3%
Government				
Federal, Civilian	13,771	12,647	-1,124	-8.2%
Military	10,516	8,474	-2,042	-19.4%
State	21,561	22,972	1,411	6.5%
Local	34,422	38,884	4,462	13.0%
Montana Total	**436,574**	**543,333**	**106,759**	**24.5%**

Source: U.S. Department of Commerce, BEA 2001.

TABLE 3-27
STATE EMPLOYMENT VERSUS PLANNING AREA EMPLOYMENT BY SECTOR (1998)

	Planning Area Employment by Sector	% of Planning Area Total by Sector	State Employment by Sector	% of State Total by Sector
Farm Employment	9,459	5.2%	32,071	5.9%
Non-Farm Employment				
Agriculture, Forestry, Fishing, and other	2,347	1.3%	8,739	1.6%
Mining	2,193	1.2%	6,730	1.2%
Construction	11,590	6.3%	33,245	6.1%
Manufacturing	8,583	4.7%	29,504	5.4%
Transportation and Public Utilities	8,450	4.6%	26,759	4.9%
Wholesale Trade	9,287	5.1%	20,693	3.8%
Retail Trade	36,475	20.0%	106,202	19.5%
Finance, Insurance, and Real Estate	11,789	6.5%	34,673	6.4%
Services	54,915	30.1%	161,740	29.8%
Government				
Federal, Civilian	3,730	2.0%	12,647	2.3%
Military	1,596	0.9%	8,474	1.6%
State	7,390	4.0%	22,972	4.2%
Local	12,137	6.6%	38,884	7.2%
Undisclosed or under 10 jobs	2,586	1.4%	N/A	N/A
Montana Total	182,527	100.0%	543,333	100.0%

Source: U.S. Department of Commerce, BEA 2001.

TABLE 3-28
PLANNING AREA EMPLOYMENT BY COUNTY AND SECTOR (1998)

Industry	Big Horn	Blaine	Carbon	Carter	Custer	Gallatin	Golden Valley	Musselshell	Park	Powder River	Rosebud	Stillwater	Sweet Grass	Treasure	Wheatland	Yellowstone
Farm Employment	13.2%	21.8%	17.9%	44.4%	6.9%	2.5%	41.7%	15.8%	6.8%	33.8%	9.7%	14.3%	22.4%	40.6%	22.1%	1.6%
Non-Farm Employment																
Agriculture, Forestry, Fishing, and other	3.0%	a	3.1%	a	1.5%	1.6%	a	a	1.7%	a	1.4%	2.5%	a	a	a	0.9%
Mining	8.7%	a	1.2%	a	b	0.4%	0.0%	3.6%	0.4%	1.7%	9.2%	a	b	0.0%	b	0.9%
Construction	3.3%	3.6%	6.8%	a	a	8.6%	a	6.5%	7.3%	a	1.5%	5.1%	9.0%	a	a	6.4%
Manufacturing	1.2%	1.2%	3.4%	1.9%	2.6%	6.4%	a	5.8%	6.3%	a	2.5%	8.9%	4.2%	0.0%	3.3%	4.3%
Transportation and public utilities	1.8%	2.2%	2.2%	3.6%	a	3.3%	b	4.3%	4.2%	5.0%	12.0%	a	a	5.7%	2.7%	6.1%
Wholesale trade	1.5%	3.6%	2.0%	0.0%	3.0%	4.0%	a	a	1.8%	1.0%	0.1%	1.6%	2.1%	a	a	7.6%
Retail trade	12.6%	14.6%	18.6%	8.0%	22.6%	21.0%	a	17.6%	21.4%	13.1%	12.3%	14.5%	20.5%	12.2%	20.5%	21.1%
Finance, Insurance, and Real Estate	3.7%	4.7%	5.9%	2.2%	5.9%	6.3%	0.0%	4.4%	5.8%	1.7%	3.3%	3.8%	5.4%	a	3.9%	7.5%
Services	30.3%	20.0%	27.0%	a	29.5%	28.5%	a	23.9%	34.7%	15.4%	34.0%	17.8%	16.3%	11.7%	22.5%	32.8%
Government																
Federal, Civilian	7.3%	6.4%	1.4%	2.0%	4.7%	1.1%	b	0.8%	0.9%	1.4%	3.2%	0.8%	1.5%	1.1%	3.6%	2.0%
Military	1.2%	1.3%	1.1%	1.0%	1.0%	0.8%	b	1.3%	1.0%	0.8%	1.0%	1.0%	0.9%	0.9%	1.1%	0.8%
State	0.8%	0.8%	0.5%	0.3%	4.1%	11.0%	b	0.8%	0.6%	1.7%	0.6%	0.5%	0.8%	1.4%	0.7%	1.9%
Local	11.4%	15.2%	8.9%	12.6%	7.7%	4.6%	16.3%	10.8%	7.0%	16.5%	9.3%	8.4%	12.2%	17.0%	12.7%	6.0%
Undisclosed or under 10 jobs	0	4.4%	0	24.0%	10.4%	0	41.9%	4.2%	0	7.8%	0	20.9%	4.6%	9.4%	6.8%	0
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: U.S. Department of Commerce, BEA 2001.
a = Not shown to avoid disclosure of confidential information but the estimates for these items are included in the totals.
b = Less than 10 jobs but the estimates for these items are included in the totals.

Unemployment

Table 3-29 presents the unemployment rate for Montana and each of the planning area counties in 1995 and 2000. In 1995, the average unemployment rates in Montana and in the planning area were essentially the same; 5.9 percent for the state and 5.8 percent for the planning area. In 2000, the average State unemployment rate had dropped to 4.9 percent while the average rate in the planning area remained at 5.8 percent.

In 2000, unemployment rates in four of the planning area counties were higher than the 16-county average: Big Horn (14.4 percent); Blaine (6.7 percent); Musselshell (7.4 percent); and Rosebud (7.5 percent). Unemployment rates in each of the counties but Musselshell are explained in part by the high unemployment rates on the Indian reservations contained wholly or partly within these counties. As indicated in Table 3-15 (in the Native Americans section of Chapter 3), unemployment on the Crow, Northern Cheyenne, and Fort Belknap Indian reservations in 1999 ranged between 14.9 percent and 22.9 percent. Consistent with trends in the rest of the state, the unemployment rate on each reservation fell between 1996 and 1999.

TABLE 3-29
AVERAGE ANNUAL UNEMPLOYMENT RATES BY COUNTY

	1995 Rate (%)	2000 Rate (%)	Percentage Point Change, 1995-2000
Big Horn County	12.7	14.4	1.7
Blaine County	9.8	6.7	-3.1
Carbon County	6.0	5.1	-0.9
Carter County	1.8	2.1	0.3
Custer County	4.6	4.3	-0.3
Gallatin County	2.7	2.7	0.0
Golden Valley County	7.6	5.7	-1.9
Musselshell County	8.6	7.4	-1.2
Park County	4.7	5.3	0.6
Powder River County	2.4	3.0	0.6
Rosebud County	9.2	7.5	-1.7
Stillwater County	5.0	4.9	-0.1
Sweetgrass County	3.7	2.5	-1.2
Treasure County	3.5	5.0	1.5
Wheatland County	5.1	4.6	-0.5
Yellowstone County	4.8	3.8	-1.0
Planning Area Total	**5.8**	**5.8**	**0.0**
Montana	**5.9**	**4.9**	**-1.0**

Source: Montana Department of Labor & Industry, Research & Analysis Bureau, Local Area Unemployment Statistics (2001a)

Unemployment rates on the reservations as measured by the Bureau of Indian Affairs are reported in Table 3-30. These rates are based on self-reported information from tribal leaders; 1999 is the latest year available. The rates calculated in this manner are substantially greater than those reported by the Montana Department of Labor and Industry (Table 3-30). They indicate unemployment at 61 percent for the Crow tribe, 71 percent for the Northern Cheyenne tribe, and 76 percent for the Fort Belknap tribe. For all tribal members in Montana, the unemployment rate was 61 percent.

Per Capita Income

Per capita income for the State of Montana and the counties in the planning area is shown in Table 3-31. In 1998, the average U.S. per capita income was $27,203, and the State average was $21,229. The average per capita income in the planning area was $17,715, only 83.4 percent of the state average. In 1998, per capita income in Gallatin and Yellowstone counties was higher than the State average, and incomes in Carbon, Custer, and Stillwater counties were more than 90 percent of the state average. On the other hand, per capita income in three counties was substantially lower: Big Horn County (62.4 percent); Carter County (61.9 percent), and Musselshell County (67.6 percent).

Between 1996 and 1998, per capita income in the planning area increased by an average of 5 percent annually, slightly greater than in the state as a whole, in which per capita income increased by 4.7 percent. Per capita income increased in all of the planning area counties between 1996 and 1998.

Government Revenue Sources

Government revenues include taxes, royalties, fees, and several other income sources. Please see the Socioeconomics Appendix for more information.

Taxes

Public finance mechanisms include taxes, royalties, and other fees paid to local, state, and federal governments. Taxes in Montana consist of property taxes, income taxes, natural resource taxes (coal, oil, and natural gas), and selective sales taxes (cigarette and alcoholic beverages). There is no general sales tax in Montana. Table 3-32 shows total taxes collected in Montana. In 2000, more than $789 million was collected in property taxes, accounting for 51.2 percent of the total state tax revenues collected. Income taxes were the second largest portion at 37.3 percent, followed by natural resources (6.5 percent), and sales taxes (5 percent).

TABLE 3-30
TRIBAL WORKFORCE AND UNEMPLOYMENT (1999)

Tribe	County	Total Tribal Enrollment	Available for Work of Total Work Force	Unemployed as % of Labor Force	Percent Employed but Below Poverty Guideline
Crow Tribe of Montana	Big Horn County	10,083	3,902	61%	38%
Northern Cheyenne Tribe	Big Horn County, Rosebud County	7,473	2,437	71%	26%
Fort Belknap Indian Community	Blaine County	5,223	2,780	76%	40%
Montana (all tribes)		61,203	26,348	61%	33%

Source: BIA 1999

TABLE 3-31
PER CAPITA INCOME, 1996-1998

	Dollars per Year			% Average Annual Increase (1996-1998)	% of State Average (1998)
	1996	1997	1998		
Big Horn County	11,987	12,418	13,239	5.1%	62.4%
Blaine County	13,357	13,764	15,358	7.2%	72.3%
Carbon County	17,798	18,901	19,745	5.3%	93.0%
Carter County	11,793	12,480	13,139	5.6%	61.9%
Custer County	18,879	19,792	20,487	4.2%	96.5%
Gallatin County	21,019	21,889	22,820	4.2%	107.5%
Golden Valley County	14,471	15,115	16,095	5.5%	75.8%
Musselshell County	13,087	14,047	14,351	4.7%	67.6%
Park County	17,578	17,756	18,708	3.2%	88.1%
Powder River County	13,593	15,061	16,314	9.6%	76.8%
Rosebud County	16,395	17,423	18,066	5.0%	85.1%
Stillwater County	18,114	18,726	19,736	4.4%	93.0%
Sweet Grass County	16,871	18,591	19,032	6.2%	89.7%
Treasure County	15,208	14,744	15,707	1.6%	74.0%
Wheatland County	14,784	16,695	16,217	4.7%	76.4%
Yellowstone County	22,173	23,168	24,425	5.0%	115.1%
Planning Area	**16,069**	**16,911**	**17,715**	**5.0%**	**83.4%**
Montana	**19,383**	**20,130**	**21,229**	**4.7%**	**100.0%**
U.S.	**24,651**	**25,924**	**27,203**	**5.0%**	

Source: Bureau of Economic Analysis 2001

TABLE 3-32
TOTAL TAXES COLLECTED IN MONTANA (2000)

	2000 Tax Revenues Collected in Montana	Percent of Total
Property Taxes	$789,786,040	51.2%
Income Taxes	$575,094,186	37.3%
Natural Resource Taxes	$100,063,319	6.5%
Selected Sales Taxes	$77,860,652	5.0%
Montana Total	**$1,542,804,197**	**100.0%**

Source: Montana Department of Revenue (2000)

The taxes and royalties assessed on oil and gas development and production are an important source of revenue for local governments and the State of Montana. The oil and gas industry pays rents, royalties, and bonuses on federal leases; production taxes on working and non-working interests in the State of Montana; and local property taxes on drilling and production equipment.

Generally, as county oil and gas production tax revenues increase (e.g., because of new oil and gas production), the property tax rate (mill levy) for the county is decreased accordingly. A percent of state-levied oil and gas production taxes are distributed to the counties based on the county where production occurred. For natural gas, 86 percent of the production taxes are distributed to the counties for local governments and schools. For oil, 60.7 percent of the production taxes are distributed to the counties. See the Socioeconomics Appendix for more information on taxes.

State Oil and Gas Lease Income

DNRC leases oil and gas, metalliferous and non-metalliferous, coal, sand, and gravel mineral rights agreements on 6.3 million acres of school trust lands, and more than 100,000 acres of other state-owned land throughout Montana. School trust lands are lands historically granted to the State of Montana to be used to support common schools and other educational and state institutions.

State mineral lease royalties are collected from production facilities located on state lands. Royalty payments are based on the volume of oil and gas produced and the price of the commodity. Rental and royalty revenues are either deposited into the appropriate permanent or distributable school trust or the state general fund. Table 3-33 presents the revenues received by the state in fiscal year (FY) 2000 from minerals management, including leases (rents) and mineral production royalties on state trust lands. Oil and gas revenues in FY 2000 were $6.6 million, or 57.2 percent of total state mineral management revenues. Oil and gas revenues comprised the largest share, with coal revenues the second largest, at 40.3 percent of the total.

The state mineral leasing program includes 2,433 oil and gas leases, 534 of which are currently productive. From FY 1999 and FY 2000, the number of oil and gas leases increased by 8.1 percent and the number of productive leases increased by 14.3 percent. In FY 2000, state lands yielded 923,777 barrels of oil, 5,050,552 million cubic feet of gas, and 375,113 gallons of condensate. Oil production declined 6.5 percent from FY 1999. However, the increase in average price from $10.50 per barrel in FY 1999 to $20.21 per barrel in FY 2000 accounted for the large increase in oil royalty revenue. Gas production in FY 2000 increased 19.6 percent, while price increased 36.0 percent compared to FY 1999, also resulting in a substantial increase in royalty revenue.

Federal Mineral Revenues

Oil and gas royalties are earned from production facilities on federal leases, units, or communitization agreements. Federal mineral lease royalties are collected on oil and gas produced based on the volume of product. Table 3-34 presents federal mineral revenue disbursements by county of origin for the 16 planning area counties and the state as a whole. Coal, gas, and oil are the main mineral products. The totals reported do not include royalties and rents from leases on Native American tribal and allotted lands.

TABLE 3-33
REVENUES RECEIVED FROM MINERALS MANAGEMENT ON STATE LANDS IN FY 2000

	FY 2000 Revenue (Dollars)
Oil and Gas	
Rentals/Bonuses/Penalties	2,966,285
Royalties	3,684,595
Seismic Exploration	11,075
Subtotal	6,661,955
Percent	57.2%
Aggregate Minerals	
Rentals	250
Royalties	245,693
Subtotal	245,943
Percent	2.1%
Coal	
Rentals	44,371
Royalties	4,649,634
Subtotal	4,694,005
Percent	40.3%
Other Minerals	
Subtotal	41,124
Percent	0.4%
Rentals/Penalties	32,246
Royalties	8,878
TOTAL	11,643,027

Source: MDNRC 2000 (www.dnrc.state.mt.us/trust/mmb.htm)

TABLE 3-34
ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS IDENTIFIED BY COUNTY OF ORIGIN, FISCAL YEAR 2000, MONTANA[1]

	Product	Sales Volume ($)	Royalty Value ($)	Disbursed to State ($)
Big Horn	Bonus		185,076	92,538
	Coal	20,416,210	20,912,616	10,456,308
	Gas	44,411	4,028	2,014
	Other Revenues		16,562	8,281
	Rent		335,127	167,564
	Subtotal		21,453,409	10,726,705
Blaine	Bonus		251,411	125,705
	Gas	1,559,733	460,736	230,368
	Oil	35,238	69,797	34,898
	Other Revenues		64,995	32,497
	Rent		105,524	52,762
	Subtotal		952,462	476,231
Carbon	Gas	166,547	45,722	22,861
	Gas Plant Products	2,789,164	89,617	44,809
	Oil	386,161	1,042,440	521,220
	Other Revenues		2,616,601	1,308,301
	Rent		76,892	38,446
	Sulfur	1,023	524	262
	Subtotal		3,871,797	1,935,899
Carter	Bonus		47,366	23,683
	Oil	865	1,888	944
	Other Revenues		22,294	11,147
	Rent		90,429	45,214
	Subtotal		161,976	80,988
Custer	Bonus		51,904	25,952
	Gas	56,563	11,875	5,938
	Other Revenues		1,135	568
	Rent		44,205	22,103
	Subtotal		109,119	54,560
Gallatin	Rent		5,127	2,564
	Subtotal		5,127	2,564
Golden Valley			0	0
Musselshell	Bonus		594	297
	Oil	5,378	2,394	1,197
	Other Revenues		1,077	539
	Rent		19,030	9,515
	Subtotal		23,095	11,547
Park			0	0

TABLE 3-34
ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS IDENTIFIED BY COUNTY OF ORIGIN, FISCAL YEAR 2000, MONTANA[1]

	Product	Sales Volume ($)	Royalty Value ($)	Disbursed to State ($)
Powder River	Bonus		39,028	19,514
	Gas	14,352	4,076	2,038
	Oil	74,079	172,508	86,254
	Other Revenues		6,796	3,398
	Rent		482,732	241,366
	Subtotal		705,139	352,569
Rosebud	Bonus		517,040	258,520
	Coal	1,612,516	1,852,468	926,234
	Oil	21,613	42,355	21,178
	Other Revenues		690,601	345,301
	Rent		220,533	110,266
	Subtotal		3,322,997	1,661,499
Stillwater	Bonus		6,766	3,383
	Oil	3,499	5,222	2,611
	Rent		26,077	13,039
	Subtotal		38,066	19,033
Sweet Grass	Bonus		8,928	4,464
	Rent		25,854	12,927
	Subtotal		34,782	17,391
Treasure	Coal	97,143	118,745	59,372
	Rent		2,760	1,380
	Subtotal		121,505	60,752
Wheatland	Other Revenues		480	240
	Subtotal		480	240
Yellowstone	Oil	1,648	2,494	1,247
	Other Revenues		516	258
	Rent		131	65
	Subtotal		3,140	1,570
Planning Area Total			30,768,312	15,384,156
% of State Total			71.8%	75.4%
Montana Total[2]			42,881,292	20,401,472

Source: U.S Department of Interior, Minerals Management Service 2001.

[1] Does not include revenues collected from American Indian lands or offshore operations.

[2] Adjusted for net receipts sharing (less $1,039,174 disbursed to state).

Mineral royalties from the 16 planning area counties totaled $30.7 million—approximately 71.8 percent of the $42.8 million collected in the state. Big Horn County accounted for a large share of the planning area revenues, with total royalties of $21.4 million, which were mostly from coal. Coal and oil revenues are far greater than gas revenues.

Formulas for disbursement of revenues from federal mineral leases are governed by legislation and regulations. Nationally, in fiscal year 2000, federal mineral lease revenues were disbursed as follows: 66.0 percent to the U.S. Treasury; 20.2 percent to special purpose funds, such as historic preservation, land and water conservation, and reclamation; 10.8 percent to states; and 3.0 percent to Native American tribes. This corresponds to $5.1 billion to the U.S. Treasury, $1.6 billion to special purpose funds, $843 million to states, and $235 million to tribes.

Federal legislation provides that Montana receive 50 percent of the net receipts of all bonuses, rents, and royalties collected on BLM-administered lands within Montana. As a result, the percentage of royalties disbursed in Montana is much greater than the national average. Of the $42.8 million in royalties collected on federal lands in Montana counties in 2000, nearly half, or $20.4 million, was disbursed to the state.

Private Landowner Revenue

Some landowners in Montana own the mineral rights to their land and lease those rights for natural gas development and other uses. Landowners who do not own mineral rights may be subject to the development of natural gas or other energy or mineral resources on their land. Both of these categories of landowners receive income for use of their land, in the form of natural gas royalties or one-time compensation for land disturbance and use, respectively. This income is included in the total per capita incomes presented in Table 3-31.

Water Resource Values

Water plays an important role in the state and local economies of Montana. Water is a scarce resource in Montana—particularly in eastern Montana. Many of the state's surface water basins are over-appropriated and have been closed to future appropriations. In these locations, water users are turning more and more to groundwater to meet their water needs.

Most of the water in the planning area originates as groundwater. Livestock watering and domestic water wells are the primary uses of groundwater in the area. Surface water and groundwater are also used for agricultural irrigation and surface water is used for recreation in some areas. Continued availability of adequate quantity and quality for these major uses is essential to maintaining the health of these sectors of the local and state economies.

The economic value of water resources for human uses varies greatly by location and by use and user. As an example, it has been estimated that the value of irrigation water to agricultural producers, based on the increase in production attributable to the use of the water for irrigation, is between $25 and $50 per acre-foot in eastern Montana (Schaefer 2001). Costs for domestic water would generally be more. The values are inherent components of the values of the various sectors of the economy, such as income from grazing and agriculture or costs of providing public water service. Changes in the supply or cost of water would contribute to changes in the costs and revenues for these activities.

Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations" (1994) requires the non-discriminatory treatment of minority populations and low-income populations for projects that occur on federal lands, require federal permits, use federal funds, or are otherwise under the jurisdiction of a federal agency. Disproportionately high or adverse health or environmental effects on such populations must be identified and addressed as appropriate.

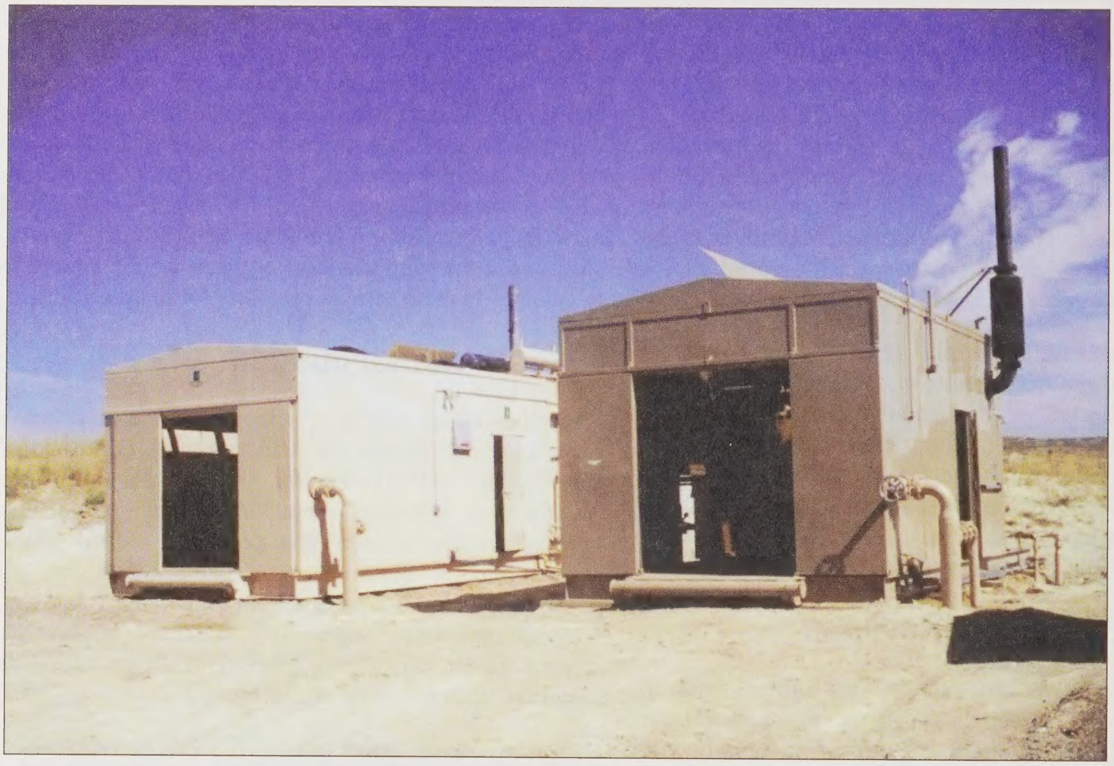
Low-Income and Minority Populations

This section describes locations of concentrations of minority populations and low-income populations at the county level, in accordance with the scope of this study. Potential sub-county concentrations of minority populations and low-income populations are also possible but could only be identified on a project-specific basis. The occurrences of minority populations and low-income populations are discussed in detail in the Demographics section of this report, and are presented in Tables 3-23 and 3-24, respectively.

The Montana population is 92.2 percent white, similar to the 16-county study area, which is 91.5 percent white. While 13 of the 16 study-area counties are between 94.5 percent and 99.1 percent white, three of the counties—Big Horn, Blaine, and Rosebud—include Indian reservations with substantial Native American populations. Big Horn County, where the population is 59.7 percent Native American, includes most of the Crow Reservation and part of the Northern Cheyenne Reservation. Rosebud County also includes part of the

Northern Cheyenne Reservation and is 32.4 percent Native American. Bighorn and Rosebud counties are two of the counties with the most potential for CBM needs. Blaine County includes most of the Fort Belknap Reservation and is 45.4 percent Native American.

The percentage of the Montana population living in poverty is 15.5 percent; the average in the 16-county study area is 17.3 percent. The study area contains 39,093 persons below the poverty level, or about 28.8 percent of the state's total below the poverty level. Nine of the 16 study-area counties have poverty rates greater than the state average. The two counties with the highest rate are Big Horn and Blaine, where more than one quarter of the population had an income below the poverty level in 1997.



Two typical field compressors. These four-stage, 6.0 million cubic foot per day, reciprocal compressors operate at 380 horsepower and use natural gas as a fuel.

Soils

Montana, with its wide mix of geologic parent material, has a vast array of different soil types. Differences in climate, parent material, topography, and erosional conditions result in soils with diverse physical and chemical properties. The distribution and occurrence of soils can be highly variable and is dependent on a number of factors including slope, geology, vegetation, climate, and age. For more information on soil types, see the Soils Appendix.

The five major soil forming factors are as follows (Brady 1990):

1. Climate—particularly temperature and precipitation.
2. Living Organisms—especially native vegetation, microbes, soil animals, and human beings.
3. Nature of parent material.
4. Topography of the site.
5. Time that parent materials are subject to soil formation.

Soils in the RMP areas are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams.

Soil salinity affects the suitability of a soil for crop production and the stability of the soil. The SAR is the measure of sodium relative to calcium and magnesium, and affects the soil structure and infiltration rate of water. The Soils Technical Report presents a more detailed discussion pertaining to the salinity and SAR of the soils in the Billings RMP and Powder River RMP areas. A summary of this report is presented in the Soils Appendix.

Solid and Hazardous Wastes

The hazardous materials program priorities are to protect the public health and safety; protect natural and environmental resources; comply with applicable federal and state laws and regulations; and minimize future hazardous substance risks, costs, and liabilities on public lands. BLM is responsible for all releases of hazardous materials on public lands and requires notification of all hazardous materials to be used or transported on public land.

Solid and hazardous wastes can be generated during oil and gas and CBM activity. These wastes are under the jurisdiction of the MDEQ for Resource Conservation and Recovery Act (RCRA) wastes; the MBOGC for RCRA-exempt wastes such as drilling wastes; and the EPA on tribal lands. At the present time, wastes generated from the wellhead through the production stream to and through the gas plant are exempt from regulation as a hazardous waste under RCRA's exploration and production exemption, but are covered by mineral leasing regulations.

The exemption does not apply to natural gas as it leaves the gas plant for transportation to market. Releases must be reported in a timely manner to the National Response Center the same as any release covered under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Prior to a gas plant, releases are reported to the BLM via a Report of Undesirable Event (NTL-3A; 43 CFR 3162.5-1(c)). The BLM requires immediate reporting of all Class I events, which involve the release of more than 100 barrels of fluid/500 MCF of gas, or fatalities. The MDEQ's Solid and Hazardous Waste Bureau is responsible for administering both the Montana Solid Waste Management Act (75-10-201 *et. seq.*, Montana Code Annotated [MCA]) and the Montana Hazardous Waste Act (75-10-401 *et seq.* MCA).

It has been established by CERCLA that the owner of the land is ultimately responsible for hazardous materials or substances placed or released on their lands. Under CERCLA, the term "hazardous substance" is typically any toxic, corrosive, ignitable, explosive, or chemically reactive substance, but does not include petroleum, crude oil, natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel, or mixtures of natural gas and synthetic gas. According to MCA 82-10-505: the oil and gas developer or operator is responsible for all damages to property, real or personal, resulting from the lack of ordinary care by the oil and gas developer or operator. The oil and gas developer or operator is responsible for damages to property, real or personal, caused by drilling operations and production. This places the liability of any cleanup that results from spills or unused non-exempt waste and the removal of such waste (paint, acid, or other chemicals) to the oil and gas developer and operator. The oil and gas industry transports hazardous materials on the highways, stores and uses the materials at the sites, and produces some hazardous wastes, such as paint waste from the painting of facilities, and unused acid or chemicals that were not used in well treatments. This presents a potential for spills, leaks, and illegal disposal. Reserve pits may be required to be lined, which reduces but does not eliminate leaks. Produced water is the predominant fluid, but some hazardous substances also are released. The content of the releases or spills will be varied and unpredictable.

The transportation of hazardous materials is regulated by Montana's Department of Transportation (MDT) under CFR Parts 171-180. These regulations pertain to packing, container handling, labeling, vehicle placarding, and other safety aspects. The transportation of all hazardous waste materials in Montana must comply with the Federal Motor Carrier Safety Regulations, part 390 through part 397.

The EPA requires manufacturers to report releases of more than 600 designated toxic chemicals into the environment. EPA compiles this data in an annual Toxics Release Inventory. Toxics Release Inventory facilities are required to report on releases of toxic chemicals into the air, water, and land. In addition, they report on offsite, pollution prevention activities and chemical recycling. The Toxics Release Inventory also provides information about potentially hazardous chemicals and their use; however, the law does not cover toxic chemicals that reach the environment from non-industrial sources, such as dry cleaners or auto service stations.

In 1998, EPA added seven new industries to the Toxics Release Inventory: metal mining, coal mining, electrical utilities that combust coal or oil, RCRA Subtitle C hazardous waste treatment and disposal facilities, chemicals and allied products wholesale distributors, petroleum bulk plants and terminals, and solvent recovery services. There are currently 19 facilities in the RMP areas that report Toxics Release Inventory information to the EPA, with most of them being related to the energy and mining industries. The Solid and Hazardous Waste Appendix contains *the Toxics Release Inventory for Montana.*

Vegetation

The land classification system developed by the University of Montana for the Montana Gap Analysis (MT-GAP) is used for this discussion because it has a large amount of detailed information about vegetation and wildlife distribution. All classification descriptions are from the MT-GAP project, and acreage estimates and calculations are based on their data results (Fisher et al. 1998).

The planning area includes six general land classes or vegetative communities: Agriculture/Urban Areas, Grassland, Shrubland, Forests, Riparian Areas, and Barren Lands. (Non-riparian wetlands are also present but are widespread and generally in relatively small areal units compared to other land classes, so are not defined separately.) The five general land classification descriptions and their subdivisions will be explained in more detail below. All of these habitats are important to a wide variety of wildlife species.

Plant Communities

Grasslands

Grasslands are among the most biologically productive of all vegetative communities because of soil nutrient retention and fast biological recycling. They are also very valuable because the vegetation is nutritious and used by livestock and by a large constituent of wildlife (Williams and Diebel 1996, Estes et al. 1982). Grassland sites are dominated by herbaceous canopy cover at greater than 15 percent, shrub cover at less than 15 percent, and forest cover at less than 10 percent (Fisher et al. 1998).

Grasslands cover an estimated 10.4 million acres of the 16 counties that make up the CBM emphasis area. This is almost twice as much land as any other vegetation type in the planning area. Those grasslands with underlying subbituminous or bituminous coal deposits cover 1.5 million acres of the Powder River RMP area and 1 million acres of the Billings RMP area. Together, the counties of Park, Blaine, and Gallatin have nearly 1 million acres of grasslands underlain by coal within their boundaries. For grassland types, see the Vegetation Appendix.

Shrublands

Shrublands are characterized by shrub covers greater than 15 percent and forest cover less than 10 percent (Fisher et al. 1998). This vegetation type is dominant on approximately 5 million acres of the CBM emphasis area. Of this, 1.8 million acres are underlain by bituminous coal deposits. Important shrubs include several species of sagebrush (*Artemisia nova*, *A. tridentata*, *A. vaseyana*, and *A. wyomingensis*). Other important shrub species in this category are bitterbrush (*Purshia tridentata*), creeping juniper (*Juniperus horizontalis*), greasewood (*Sarcobatus* spp.), mountain mahogany (*Cercocarpus* spp.), rabbitbrush (*Chrysothamnus* spp.), and shadscale (*Atriplex canescens*). These shrublands are often associated with a complex of understory grasses such as bluebunch wheatgrass (*Agropyron spicatum*), blue grama (*Bouteloua gracilis*), Idaho fescue (*Festuca idahoensis*), needle and thread (*Stipa comata*), and western wheatgrass (*Agropyron smithii*).

Forests

Land is classified as forest if it has more than 10 percent tree cover. Montana has 19 categories of forests under this classification. Within the emphasis area, 4.5 million acres are classified as forest. Of that, almost 1.4 million acres are underlain by subbituminous or bituminous coal deposits. Two forest types account for the majority of the forested areas within the emphasis area: Ponderosa Pine Forests and Low-Density Xeric Forests. Ponderosa Pine sites are dominated by ponderosa pine (*Pinus ponderosa*) at 20 to 80 percent cover. They are associated with big sagebrush, ninebark, snowberry, bluebunch wheatgrass, blue grama, and Idaho fescue. Low-density xeric forests have tree cover at 5 to 20 percent with a grass understory. Dominant tree species are Douglas fir, limber pine, ponderosa pine, Rocky Mountain juniper, or Utah juniper (Fisher et al. 1998).

Riparian Areas

These are sites that are associated with intermittent and perennial water sources or with woody draws. Riparian areas are classified as Conifer, Broadleaf, Mixed Broadleaf and Conifer, Graminoid and Forb, Shrub, and Mixed (Fisher et al. 1998). All riparian types have high species richness, which reaffirms why riparian sites are considered to be some of the most biologically diverse habitats anywhere.

Other Wetlands

Wetlands not associated with streams or rivers (riparian) are found in many low areas across Montana. In general, these wetlands (palustrine) are dominated by either emergent marsh vegetation, such as cattails, sedges, and/rushes, or by shrub vegetation, such as willows. Forested wetlands many also be present in some areas.

Barren Lands

These are sites with less than 10 percent forest cover, less than 10 percent shrub cover, and less than 10 percent herbaceous cover (Fisher et al. 1998). The category name may imply that these areas have no biological value, but this would be misleading.

Noxious Weeds

Although the word "noxious" means harmful or deleterious, in this context it is a legal term for species of plants that have been designated "noxious" by law. Noxious weeds are non-native species with the potential to spread rapidly—usually through superior reproductive capacity, competitive advantage mechanisms, and lack of natural enemies.

Fourteen species have been defined as Category 1 noxious weeds for Montana; these weeds are currently known to be established within the state. Approximately 87,365 acres within the CBM emphasis area that are underlain by subbituminous or bituminous coal beds are considered to be altered by exotic or introduced plant species (defined by 30 percent or more of vegetative cover coming from non-native species). Not all of these are in the "noxious" weed category, but this switch from native plants is an indication of the potential scope of the issue.

- **Spotted Knapweed** (*Centaurea maculosa*): Since the 1920s, this perennial has spread from western Montana to every county in Montana. It covers an estimated 5 million acres of Montana land. This species readily establishes itself on disturbed sites and has the competitive advantage over many native species because it starts growth early in spring.
- **Diffuse Knapweed** (*Centaurea diffusa*): This aster invades roadsides, waste areas, and dry rangelands. It is highly competitive and able to exclude many native species.
- **Hoary Cress (Whitetop)** (*Cardaria chalepensis*): This invader is well adapted to moist habitats such as sub-irrigated pasture, hay fields, rangelands, and roadsides. In unshaded areas that have been disturbed, it can form dense monocultures.
- **Dyer's Woad** (*Isatis tinctoria*): This species was first reported in Montana in the 1950s. It tends to invade dry, rocky soils in rugged terrain. A chemical in the seedpods can inhibit the germination of seeds from other plants. It has been confirmed to be in two counties within the planning area: Musselshell and Park.
- **Oxeye Daisy** (*Chrysanthemum leucanthemum*): This perennial invades by both prolific seed production and by branching rhizomes and adventitious roots. It prefers upland pastures and meadows, but also grows along waste areas in western and southern Montana.
- **Dalmatian Toadflax** (*Linaria dalmatica*): This species grows in a wide range of habitats, especially if soils are well drained and coarse-textured. Wet conditions seem to limit the success of this species.
- **St. John's Wort** (*Hypericum perforatum*): This perennial covers about 500,000 acres in Montana. It is particularly adapted to sandy or gravelly soils. It reproduces by both seeds and short runners.
- **Leafy Spurge** (*Euphorbia esula*): Leafy spurge began to invade eastern Montana as early as 1925 and now is known to be in every county. It is most aggressive in dry areas where competition from native plants is less robust.
- **Purple Loosestrife** (*Lythrum salicaria*): This species' fast growth and enormous reproductive ability allow it to choke native vegetation out of wetlands.
- **Saltcedar** *(Tamarix ramosissima):* Saltceder is an aggressive woody invader. It prefers waterways and ponds and can transpire up to 200 gallons of water per day. It forms dense monocultures that provide little or no habitat for wildlife. It exudes salts onto the surrounding surface rendering the inter-spaces uninhabitable to other vegetation.

See the Vegetation Appendix for a complete list of noxious weeds for Montana.

Species of Concern

Many federally listed threatened, endangered, or candidate species of special concern exist in the planning area that are given special consideration under Section 7(c) of the Endangered Species Act of 1973 (ESA). As required by the ESA, the FWS has provided a list of endangered, threatened, and proposed species that may be present in the planning area (see Table 3-35). This section reviews its habitat requirements, as well as the likelihood of this species being found in the 16 counties that may be potentially affected.

TABLE 3-35
ENDANGERED, THREATENED, AND PROPOSED PLANT SPECIES PRESENT IN THE CBM EMPHASIS AREA

Common Name	Scientific Name	Habitat in Montana	Federal Status*
Ute ladies'-tresses orchid	*Spiranthes diluvialis*	River meander wetlands in Jefferson, Madison, Beaverhead, and Gallatin counties	T

*T = Threatened

Ute Ladies'-Tresses Orchid

This plant was listed as Threatened January 17, 1992 (57 Federal Register [FR] 2053). Ute ladies'-tresses orchid (*Spiranthes diluvialis*) is endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams. It occurs primarily on sites subject to intermittent and unpredictable inundation, and the plants often emerge from shallow water (Sheviak 1984, FWS 1996).

The species occurs primarily in areas where the vegetation is relatively open and not overly dense, overgrown, or overgrazed (Coyner 1989, 1990, Jennings 1989, 1990). In Montana, it is found in meandered wetlands and swales in broad, open valleys, at margins with calcareous carbonate accumulation (Montana NRIS 2001). It is known to occur only in southwestern Montana in Beaverhead, Gallatin, Jefferson, and Madison counties.

State Species of Concern

In addition to species that are federally protected under the ESA, the State of Montana has designated additional species of concern within its jurisdictional boundaries. There are five rankings for State Species of Special Concern. This document focuses only on the highest ranking (S1). This ranking is defined as critically imperiled because of extreme rarity (five or fewer occurrences, or very few remaining individuals), or because some factor of its biology make it especially vulnerable to extinction.

State-listed species (with BLM and Forest Service rankings) that have potential distributions within the 16-county emphasis area of this EIS or that have undefined distributions in the state are listed in the Vegetation Appendix (see Plant Species of Concern in the 16 County Planning Area). Species that are federally listed under the ESA have been omitted from these tables because they have already been considered. The Vegetation Appendix also includes the type of habitat where they are likely to be found. (Montana NRIS 2001). Table VEG-6 links wildlife species to habitat requirements.

Plant species are listed by county where each state species of concern is known to occur (Vegetation Appendix). Sensitive species for the BLM and USFS are also listed in this appendix. Historic maps for most species of concern show much wider distributions than present distributions.

Visual Resource Management

Visual resources are visual features in the Montana landscape that include landform, water, vegetation, color, adjacent scenery, uniqueness or rarity, structures, and other man-made features. The 16 counties in the emphasis area portray a variety of landscapes and habitats, all with different visual qualities. Current visual resource management is in accordance with the two RMPs. The four classes are as follows:

- Class I—preserve the existing character of the landscape
- Class II—retain the existing character of the landscape
- Class III—partially retain the existing character of the landscape
- Class IV—provide for management activities that require major modifications to the existing character of the landscape

Non-federal land is not under any visual resource management system although there are often visual quality concerns. Federally authorized projects, however, undergo a visual assessment to comply with aesthetic requirements. Typically, sensitive areas include residential areas, recreation sites, historical sites, significant landmarks or topographic features, or any areas where existing visual quality is valued.

Three CBM well heads forming a field pod near Decker, Montana. Each well is drilled to a different depth and into a different layer of coal.

Wilderness Study Areas

Ten wilderness study areas are within the planning area:

- Carbon County
  - Burnt Timber Canyon WSA
  - Pryor Mountain WSA
  - Big Horn Tack-On WSA
- Golden Valley County
  - Twin Coulee WSA
- Park County
  - Yellowstone River Island WSA
- Blaine County
  - Stafford WSA
  - Ervin Ridge WSA
  - Cow Creek WSA
- Rosebud County
  - Zook Creek WSA
- Powder River County
  - Buffalo Creek WSA

Monitoring reports for these WSAs list little or no activity with the exception of some minor vehicle tracks found in the Cow Creek WSA, Stafford WSA, Pryor Mountain WSA, Big Horn Tack-On WSA, and Burnt Timber Canyon WSA.

Wildlife

The EIS planning area covers very large portions of southeast, south central, and north central Montana, and includes substantial geographic and topographic variation and a wide variety of plant communities and wildlife habitat types. This combination of factors results in very diverse wildlife communities, with some species having widespread occurrence throughout the planning area and others being restricted to one or a few specialized habitats and locations.

The Vegetation section described the predominant native plant communities that provide habitat for wildlife in the planning area. These include a variety of grassland, shrubland, forest, and riparian habitat types. Drier grasslands and shrublands are dominant with breaks, badlands, coulees, wooded draws, open conifer forests, and riparian shrub and forest communities along perennial and intermittent drainages. Two other cover types present in the planning area include open water and a variety of agricultural land uses, both of which provide important habitat value to certain species during some seasons. Additionally, special habitat features such as cliffs, snags, springs, natural potholes, reservoirs, lakes, and islands are present in the planning area.

Mammals

The variety of locations, topography, and cover types in the planning area support many mammal species. The MT-GAP atlas of terrestrial vertebrates (MT-GAP 1998) shows the known distribution of vertebrates in Montana. It indicates that the planning area supports 10 species of bats; 8 species of shrews; 34 other species of small mammals and lagomorphs; 17 omnivores or predators ranging in size from the least weasel (*Mustela nivalis*) to the black bear (*Ursus americanus*) and mountain lion (*Felis concolor*); and 5 to perhaps 7 big game species. Several of these species have suffered substantial habitat loss and population decline and are considered to be rare or are protected by federal statutes. These species are addressed in the Species of Concern (SOC) section.

Some of the more common predators include the coyote (*Canis latrans*), red fox *(Vulpes vulpes*), raccoon (*Procyon lotor*), badger (*Taxidea taxus*), and striped skunk (*Mephitis mehpitis*). Local occurrence of several of these and other predators varies by habitat type present.

Big game species common within parts or all of the planning area include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), and pronghorn (*Antilocapra americana*). The MT-GAP (1998) provides the following summary of habitat preferences for these species.

Elk habitat preference is described as including moist sites during the summer. Elk use open areas such as alpine pastures, marshy meadows, river flats, and aspen parkland as well as coniferous forests, brushy clearcuts, and forest edges. High-quality winter range is critical to long-term elk survival.

Mule deer are the most widely distributed big game species in Montana and occupy a wide range of habitat types during the year. Breaks, badlands, and brushy draws are preferred in open prairie country. McCracken and Uresk (1984) reported that both hardwood and pine forests were important to mule deer in southeastern Montana, with hardwood forests preferred. The Billings RMP (BLM 1983) indicates that although mule deer occur throughout the planning area, they are more abundant in the open shrub-grassland habitats adjacent to timbered or broken terrain. Habitat such as riparian bottoms, agricultural areas, and forests are used as well, either year long or seasonally. Winter ranges are typically at lower elevation than summer ranges, and are often dominated by shrub species that provide crucial browse.

White-tailed deer also occur throughout Montana but are more restricted by habitat preference than are mule deer. Preferred habitats include forest types, agricultural fields, and prairie areas adjacent to cover. Mesic areas such as riparian areas and montane forests are preferred in the drier portions of central and eastern Montana. McCracken and Uresk (1984) reported a strong preference for hardwood forests in southeastern Montana. During the winter, white-tailed deer using forested areas prefer dense canopy classes, moist habitat types, uncut areas, and low snow depths. Winter concentration areas occur almost exclusively in riparian-wetland habitats and in dense pine (Youmans and Swenson 1982). White-tailed deer tend to remain in one particular area and do not migrate in the winter (Hamlin 1978).

Pronghorn are relatively common throughout eastern and central Montana and occupy a variety of grassland and shrubland habitats on prairies, semi-desert areas, and foothills. Summer habitat preferences are reported to include mixed shrub communities, perennial grasslands, silver sagebrush stands, annual forblands, and croplands (Armstrup 1978, Wentland 1968). McCracken and Uresk (1984) reported a strong preference to sagebrush-grassland cover types in southeastern Montana. Sagebrush-grasslands with shrubs 12 to 24 inches tall are preferred in the winter when sagebrush composes a significant portion of the pronghorn diet (Bayless 1967).

The range of moose (*Alces alces*) overlaps with coal-bearing lands in Carbon County. Moose habitat generally consists of a mosaic of second-growth forest, openings, swamps, lakes, and wetlands. Water bodies are required for foraging and hardwood-conifer forests provide winter cover. Willow flats may provide yearlong habitat in some areas (Stone 1971) and closed canopy stands may be important in late winter (Mattson and Despain 1985).

The other two big game species that may occur in the planning area include the mountain goat (*Oreamnos americanus*) and mountain bighorn sheep (*Ovis canadensis*). Mountain goats typically occupy alpine and subalpine habitats, steep grassy talus slopes, grassy ledges and cliffs, or alpine meadows. Both mountain goats and mountain sheep may overlap with coal-bearing lands in southwestern and southern Carbon County, respectively. The Pryor Mountain bighorn herd, which occurs south of Billings, is estimated at 100 individuals (BLM 1983). Grasses and forbs provide the major portion of their yearlong diet, which is supplemented with browse types such as curlleaf mountain mahogany and sagebrush (FWS 1978). Little information is currently available on the migratory routes of this herd.

In eastern Montana, most mule deer and elk winter range is located on relatively large areas of land with a diversity of slopes, aspects, and topographic features (MBOGC 1989). Winter range is often part of year-round habitat.

Prairie dog towns provide habitat for more than 163 vertebrate species, including several rare or endangered species such as the burrowing owl (*Athene cunicularia*), swift fox (*Vulpes velox*), mountain plover (*Charadrius montanus*), and black-footed ferret (*Mustela nigripes*)—which is an endangered species (Reading et al. 1989, Koford 1958, Tyler 1968, Campbell and Clark 1981, Clark et al. 1982, and Agnew 1983). Black-tailed prairie dogs (*Cynomys ludivicianus*) formerly occupied most of the planning area along with thousands of acres of adjacent short grass prairie lands. White-tailed prairie dogs (*C. leucurus*) are found only along the Clarks Fork of the Yellowstone River in Carbon County, which is at the northern limit of its range.

As noted above, at least 10 species of bats probably occur in the planning area. Additional species migrate through central and eastern Montana. These sites vary by species and include caves, large-diameter hollow trees, old buildings, abandoned mines, rock crevices, and under the loose bark on large trees.

As noted above, at least 42 species of shrews and other small mammals and lagomorphs occur in the planning area. MFWP has expressed particular concern about the Preble's shrew (*Sorex preblei*) and Merriam's shrew (*S merriami*). Preble's shrew has a spotty distribution associated with dry sagebrush and sagebrush grasslands (Hoffman and Pattie 1968) and riparian shrubs (Allen et al. 1994, Ports and George 1990). Merriam's shrew is apparently somewhat more widely distributed in the planning area. It occupies the same general habitat types as the Preble's shrew plus grasslands and open ponderosa pine stands (MT-GAP 1998).

Birds

As noted for mammals, the variety of locations, topography, and cover types in the planning area also support many bird species. The MT-GAP (1998) indicates that more than 250 species of birds occur in the emphasis area. Some are yearlong residents, a few migrate south into the emphasis area during the winter, and most breed in the emphasis area and winter to the south. Approximate numbers of species include 32 waterfowl and related species; 33 shore and wading birds; 18 diurnal and 11 nocturnal raptors; 8 species of gallinaceous birds; 8 woodpeckers; and 137 songbirds, including many neotropical migrants. Species richness and breeding bird densities are highest in riparian woodlands and wetland habitats.

Waterfowl

The planning area is within the Central Flyway, which has important migration corridors. Lands in the planning area also fall within the Prairie Pothole Joint Venture established through the North American Waterfowl Management Plan. The Prairie Pothole Joint Venture is thought to contain the most important duck-breeding habitat in North America. Many spring runoff ponds in the planning area provide important habitat for nesting waterfowl. The major rivers and stockponds provide important habitat for resident ducks and nesting areas for migrants. A large variety of ducks, geese, and shorebirds use riparian-wetland habitats within the planning area for both nesting and migration stopovers. Common species include the mallard (*Anas platyrhynchos*), pintail (*A. acuta*), gadwall (*A. strepera*), blue-winged teal (*A. discors*), common merganser (*Mergus merganser*), Canada goose (*Branta canadensis*), killdeer (*Charadrius vociferus*), and avocet (*Recurvirostra americana*). The Yellowstone and Clarks Fork drainages are used heavily for nesting by Canada geese and some species of ducks. Nesting occurs mostly on established islands and brushy riparian-wetland areas where abundant cover provides protection from predators.

Hansen (2001) identified several specific areas that are important to waterfowl and shorebirds. One critical habitat (for waterfowl and shorebird nesting and migration) is the Lake Mason National Wildlife Refuge (NWR), its entire watershed, and some associated shallow lakes located in Mussellshell County. Another is the Spidel Waterfowl Production Area, another FWS area for waterfowl and shorebirds located at the edge of one of the coal areas about 3 miles northeast of Broadview. A group of major waterfowl and shorebird areas located in Stillwater County between Molt and Rapelje includes Big Lake, Halfbreed NWR, and Hailstone NWR.

The Yellowstone River through Yellowstone, Big Horn, Treasure, Rosebud, and Custer counties is a major habitat for nesting, migrating, and wintering waterfowl. Also, the Howrey Island ACEC is a large island in the Yellowstone River in Treasure County that provides valuable habitat for waterfowl and many other species.

In Blaine County there are a number of large and small wetlands within the coal area that are important to waterfowl and shorebirds. These include North Chinook Reservoir and the Holm Waterfowl Production Area about 20 miles north-northwest of Chinook, and Tule Lake and BR12, about 10 miles north of Zurich. Smaller wetlands in this area are collectively extremely important. This is an important nesting area for northern pintails, a species of duck that has declined in numbers.

Raptors

Many of the raptors occurring in the planning area have been identified by the State of Montana, the USFS, or BLM as sensitive species or species of special interest or concern (Flath 1991, Houtcooper et al. 1985). Those listed by the state include the ferruginous hawk (*Buteo regalis*), osprey (*Pandion haliaetus*), Cooper's hawk (*Accipiter cooperii*), northern goshawk (*Accipiter gentilis*), golden eagle (*Aquila chrysaetos*), merlin (*Falco columbarius*), prairie falcon (*Falco mexicanus*), burrowing owl, flammulated owl (*Otus flammeolus*), great gray owl (*Strix nebulosa*), and Boreal owl (*Aegolius funereus*). The endangered bald eagle (Haliaeetus leucocephalus) is discussed in the Species of Concern section.

Burrowing owls are of particular interest because of the rapid decline in their numbers (MT-GAP 1998). They occur in a variety of open habitat types, nesting and roosting in burrows dug by mammals (AOU 1983). They appear to be totally dependent on these mammal burrows with prairie dog towns providing prime habitat (MT-GAP 1998).

Ferruginous hawks occupy relatively undisturbed prairie and shrub steppe regions with scattered trees, rock outcrops, and wooded stream bottoms (Evans 1982, Clark et al. 1989). MFWP notes that there are a few pairs that apparently nest along tributaries in both the Powder River and Tongue River watersheds. Ferruginous hawks have declined throughout their range over the last 30 years. Merlins have also suffered substantial population declines. They occur in sparsely treed prairie, prairie parkland, along stream bottoms, and in grassland habitats. MFWP notes that merlin were present in the Powder River watershed, but that little current information is available.

Upland Game Birds

The following section from the Billings and Powder River RMPs describes habitat preferences and important natural history information for the prairie sharp-tailed grouse *(Tympanuchus phasianellus jamesi*) and greater sage grouse (*Centrocercus urophasianus*) that applies to the entire planning area. Sharp-tails are widely distributed and are generally found in the grassland, shrub-grassland, and woodland vegetation areas. Sharp-tail habitat includes hills, benchlands, and other areas of rolling topography that have good stands of residual cover composed chiefly of grasses for roosting, feeding, and nesting. Dancing grounds, or leks, are usually flat areas on elevated knolls or benches. The dancing or mating sites are nearly bare of vegetation, although brushy cover is located nearby for feeding and escape. The breeding and nesting period from March to June is the most critical period in the life cycle. Females nest and raise their broods in the grassy uplands, usually within 1 mile of mating grounds.

Studies in southwestern North Dakota have shown that more than 90 percent of the nest sites were in residual vegetation over 6 inches high, and 70 percent of brood locations were in vegetation over 9 inches high (Kohn 1976). Habitat preferences in this planning area are similar.

Sage grouse are discussed under *Species of Concern* later in this Wildlife section.

Neotropical Migrants

A wide variety of neotropical migrants pass through or breed in the planning area. Habitat types that would be expected to support the highest species richness and highest breeding densities include cottonwood and ash riparian communities (Hopkins 1984) and emergent wetland communities. Hansen (2001) indicated that large blocks of native grasslands in Blaine County are very important to several species of birds that are declining in numbers, including Baird's sparrow (*Ammodramus bairdii*), Sprague's pipit *(Anthus spragueii*), chestnut-collared longspur (*Calcarius lapponicus*), and McCown's longspur (*Calcarius mccownii*). A number of other bird species, including the Brewer's sparrow (*Spizella breweri*), and loggerhead shrike (*Lanius ludovicianus*), are also declining throughout their range.

Reptiles and Amphibians

The MT-GAP (1998) indicates that the emphasis area supports 9 species of amphibians and 14 species of reptiles. These include 1 salamander, 4 frogs, 4 toads, 3 turtles, 2 lizards, and 9 snakes. MFWP has expressed particular concern about 5 of these species including the northern leopard frog (*Rana pipiens*), tiger salamander (*Ambystoma tigrinum*), hognose snake (*Heterdon nasicus*), milk snake (*Lampropeltis triangulum*), and the spiny softshell turtle (*Trionyx spiniferus*).

Leopard frogs have declined substantially in western, and to a somewhat lesser extent, central Montana (MT-GAP 1998). They are locally abundant in southeastern Montana (Reichel and Flath 1995). They are associated with permanent slow moving water bodies with considerable vegetation, but may also range into moist meadows and grassy woodlands and occasionally agricultural areas (Nussbaum et al. 1983). They are most often associated with riparian habitats and on prairies near permanent water. Tiger salamanders occur throughout the planning area wherever there is terrestrial substrate suitable for burrowing and a nearby body of water for breeding (MT-GAP 1998). All amphibians are particularly susceptible to adverse effects of water quality degradation because larval stages are spent in water and they absorb water through their skin during all life stages.

The western hognose snake occurs in a variety of habitats throughout central and eastern Montana. They are especially associated with arid areas, prairie grasslands and shrublands, and floodplains with gravely or sandy soils (Reichel and Flath 1995). Milk snakes occur in suitable habitats throughout south central and southeastern Montana. Preferred habitats include sandstone bluffs, rock outcrops, grasslands, and open ponderosa pine and juniper stands (Hendricks and Reichel 1996). The spiny softshell is a riverine species that occurs primarily in the larger rivers of southeastern Montana. It is found in well-oxygenated, slower moving water with nearby mud flats and sandbars, and occasionally in back water sloughs (MT-GAP 1998).

Species of Concern

This section discusses wildlife species of concern that occur in the planning area. These include species listed or proposed for protection under the ESA, species classified as sensitive by the BLM or Forest Service, and species considered to be critically imperiled in the State of Montana. Table 3-36 and the following discussion present information about the species protected under ESA.

Birds

Sage Grouse

Sage grouse are widely distributed in suitable habitat, but because their numbers have been declining throughout their range, including Montana, over the last 20 years they are a possible candidate for listing under the ESA. Sage grouse are primarily associated with big and silver sagebrush communities in grassland-shrub and shrub vegetation types. The importance of mature sagebrush with a good understory of grasses and forbs to sage grouse is well documented.

Sage grouse males appear to form leks opportunistically at sites within or adjacent to potential nesting habitat. Although the lek may be an approximate center of annual ranges for non-migratory populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1975), this may not be the case for migratory populations (Connelly et al. 1988, Wakkinen et al. 1992). Average distances between nests and nearest leks vary from 0.66 to 3.75 miles but documented distances from leks with which females were associated to their nests have exceeded 12 miles. (Autenrieth 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000). Nests are placed independent of lek location (Bradbury et al. 1989, Wakkinen et al. 1992). Nesting habitat is usually located under sagebrush, and with about 50 percent of nests located within 2 miles of leks (Wallestad and Pyrah 1974, Martin 1970).

TABLE 3-36
ENDANGERED, THREATENED, AND PROPOSED ANIMAL SPECIES PRESENT IN THE CBM EMPHASIS AREA

Common Name	Scientific Name	Habitat in Montana	Federal Status*
Birds			
mountain plover	*Charadrius montanus*	Arid, shortgrass prairieland in eastern Montana	PT
bald eagle	*Haliaeetus leucocephalus*	Forested riparian areas throughout the state	T
interior least tern	*Sterna antillarum athalassos*	Sandbars and beaches in eastern Montana and along the Yellowstone and Missouri rivers	E
Mammals			
gray wolf	*Canis lupus*	Adapted to many habitats, need large ungulate prey base and freedom from human influence	E/10(j)
black-tailed prairie dog	*Cynomys ludovicianus*	Short-grass and mixed-grass prairie in the east of the 110th Meridian; concentrations are in southern Phillips County, Custer County, Blaine County, Fort Belknap Reservation, and Crow Reservation	C
Canada lynx	*Felis lynx canadensis*	Montana spruce/fir forest in western Montana	T
black-footed ferret	*Mustela nigripes*	Prairie dog complexes in eastern Montana	E
grizzly bear	*Ursus arctos horribilis*	Alpine/subalpine coniferous forest in western Montana	T

*T = Threatened; E = Endangered; C = Candidate; PT = Proposed Threatened; E/10(j) = Endangered/Experimental Populations.

Sagebrush provides 80 to 100 percent of their winter diet (Wallestad and Schladweiler 1975, Martin 1970, Eng and Schladweiler 1972). For winter, sage grouse prefer an area where sagebrush shrubs are at least 12 inches high (BLM 1995). Forbs, especially dandelion and salsify, are an important dietary component for the juveniles and adults in the spring and summer and wet meadows and other riparian areas are heavily used in the summer as sagebrush areas dry out.

Mountain Plover

This species has been proposed for listing as threatened. It was once widely distributed across shortgrass prairies on the western Great Plains, occupying a range extending from Montana to New Mexico and Texas. Conversion of native prairies to agriculture has significantly reduced suitable breeding habitats for this species. It prefers level sites with very short grass and scattered cactus. Intensive grazing is beneficial for mountain plovers, and they also regularly occupy prairie dog towns. High, arid plains and shortgrass prairie with blue grama-buffalo grass communities are the primary habitat. The mountain plover does not winter in Montana, but may breed within the planning area, particularly in black-tailed prairie dog towns. It currently breeds in central, north-central, and southwest Montana and is transitory in other parts of Montana, such as the Greater Yellowstone Ecosystem. Blaine and Phillips counties currently support the bulk of mountain plovers that nest in Montana.

Bald Eagle

This species was reclassified from endangered to threatened, because of recovery status, on July 12, 1995. Bald eagles concentrate in and around areas of open water where waterfowl and fish are available. They prefer solitude, late-successional forests, shorelines adjacent to open water, a large prey base for successful brood rearing, and large, mature trees for nesting and resting.

Bald eagle recovery zones include the Powder and Missouri rivers. Bald eagles commonly nest along the Yellowstone River in Rosebud and Custer counties. The Yellowstone River is used during spring and fall migration. Peak occurrence is November through April. The Missouri, Yellowstone, Musselshell, and Powder rivers provide habitat during migration as well as during the winter months. Bald eagles currently are expanding their nesting territories down the Yellowstone River (Flath 1991).

Interior Least Tern

The historic distribution of the interior least tern is the major river systems of the plains states and midwestern U.S. The occurrence of breeding least terns is localized and is highly dependent on the presence of dry, exposed sandbars and favorable river flows that support a forage fish supply and isolate the sandbars from the riverbanks. Characteristic riverine nesting sites are dry, flat, sparsely vegetated sand and gravel bars within a wide, unobstructed, water-filled river channel. In the upper Missouri River Basin, it often nests with piping plovers. During spring and fall migrations, the least tern uses stockwater reservoirs (Flath 1991).

The least tern is known to nest in the planning area. Its habitat includes graveled islands in the lower Yellowstone River and the Missouri River below Fort Peck Dam.

Peregrine Falcon

The peregrine falcon was delisted on August 25, 1999, and protection from take and commerce for the peregrine falcon is no longer provided under the ESA. However, peregrine falcons are still protected by the Migratory Bird Treaty Act (MBTA). The MBTA and its implementing regulations (50 CFR parts 20 and 21) prohibit take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase, or barter any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit (50 CFR 21.11). With limited exceptions, take will not be permitted under MBTA until a management plan is developed in cooperation with state wildlife agencies, undergoes public review, is approved, finalized, and published in the FR.

Peregrine falcons migrate through the planning area during spring and fall, especially along rivers and other water bodies that support waterfowl and shorebirds. Peregrines are believed to nest northeast of Great Falls, possibly within the planning area.

Mammals

Gray Wolf

This species was listed as endangered on March 11, 1967. On November 18, 1994, the FWS announced that experimental populations of this species would be reintroduced in central Idaho and southwestern Montana. Populations classified as experimental are exempt from full endangered status. Historically, the gray wolf ranged throughout Montana. It appears to have been common throughout the state, inhabiting both short and tall grass prairie as well as forested regions. It has no particular habitat preference, but requires areas with low human population, low road density, and high prey density, which are ideally large, wild ungulates.

Most confirmed wolf sightings and pack accounts are for western Montana, along the Bitterroot divide, and in the areas around Yellowstone National Park, where it has been reintroduced (Fisher et al. 1998).

Black-tailed Prairie Dog

This species was proposed for listing as threatened on March 25, 1999. On February 3, 2000, the FWS determined that the black-tailed prairie dog warrants listing under the ESA. However, because there are other species also awaiting listing that are in greater need of protection, the FWS is not proposing to list the species at this time, but it still remains a candidate for listing.

Although the original abundance of prairie dogs in Montana is unknown, early accounts indicate they were abundant and widely distributed east of the Continental Divide in grasslands and sagebrush-grasslands. This species is capable of colonizing a variety of shrub-grassland and grassland habitats. Generally, the most frequently used habitats in Montana are dominated by western wheatgrass, blue grama, and big sagebrush and located in relatively level areas in wide valley bottoms, rolling prairies, and the tops of broad ridges. The black-footed ferret is an obligate predator of prairie dogs. Other species with close associations to prairie dogs are burrowing owls, mountain plovers, and ferruginous hawks. These are all species of concern.

Canada Lynx

This species was listed as threatened on March 24, 2000. It is dependent on snowshoe hares and found in the same habitats, which include dense, mature old-growth lodgepole pine, Douglas fir, Engelmann spruce, and subalpine fir forest. Distribution and primary potential habitats for Montana are in the western portion of the State in mature coniferous forests with a well-developed understory. Dens are primarily located in mature lodgepole pine and spruce-fir forests.

Black-footed Ferret

This species was listed as endangered on March 11, 1967. Black-footed ferrets depend almost exclusively on prairie dogs for food and shelter. They primarily prey on prairie dogs and use their burrows for shelter and dens. Ferret range is coincident with that of prairie dogs. There is no documentation of black-footed ferrets breeding outside of prairie dog colonies. There are specimen records of black-footed ferrets from ranges of three species of prairie dogs: the black-tailed prairie dog (*Cynomys ludovicianus*), white-tailed prairie dog (*Cynomys leucurus*), and Gunnison's prairie dog (*Cynomys gunnisoni*).

Several releases of black-footed ferrets have taken place over the last four years on public land and the Fort Belknap Indian Reservation north of the planning area in Phillips County, Montana.

Grizzly Bear

This species was listed as threatened on March 11, 1967. On November 11, 2000, the FWS listed some populations in Montana and Idaho as experimental in order to facilitate restoration to designated recovery areas. The grizzly (or brown) bear was once found in a wide variety of habitats including open prairie, brushlands, riparian woodlands, and semidesert scrub. Its distribution in Montana is now limited to the Northern Continental Divide Ecosystem and the Yellowstone Ecosystem with a few in the Cabinet-Yaak Ecosystem. Scattered individuals may occur in the mountainous areas of western Montana. It no longer exists in the wild in eastern Montana. Most populations require vast areas of suitable habitat to prosper. This species is common only in habitats where food is abundant and concentrated, including white-bark pine, berries, and salmon or cutthroat runs, and where conflicts with humans are minimal.

State Species of Special Concern

In addition to species that are federally protected under the ESA, the State of Montana has designated additional species of concern within its jurisdictional boundaries. There are five rankings for State Species of Special Concern. This document focuses only on the highest ranking (S1). This ranking is defined as critically imperiled because of extreme rarity (five or fewer occurrences, or very few remaining individuals), or because some factor of its biology makes it especially vulnerable to extinction.

State-listed species (with BLM and USFS rankings) that have potential distributions within the 16-county emphasis area of this EIS or that have undefined distributions in the state are listed in the Wildlife Appendix, *Wildlife Species of Concern* (see Table WIL-1 for Special Status Species of State of Montana, BLM, and USFS). Species that are federally listed under the ESA have been omitted from these tables because they have been considered. Table WIL-1 also lists vertebrate species that are species of concern for the state, BLM, or the USFS.

Aquatic Resources

Aquatic habitat in the CBM emphasis area that supports, or could potentially support, fisheries and other aquatic resources briefly described in the following paragraph includes rivers, streams, lakes, and stock ponds. Extensive information on aquatic habitat and fisheries resources in the Billings and Powder River RMP areas and in Gallatin, Park, and Blaine counties is contained in the Montana NRIS on the Internet at http://nris.state.mt.us/wis/mris1.html (Montana NRIS 2001).

Tables WIL-2 through WIL-5 in the Wildlife Appendix summarize representative planning area information from the Montana NRIS (2001) Internet data base. Table WIL-2 summarizes aquatic resources characteristics of major drainages and representative tributaries within the boundaries of each RMP area and county. These characteristics include drainage length, aesthetics, fisheries management, fisheries resource value, number of fish species present, and whether a dewatering problem has been identified. The relative abundances of fish species present in major drainages and representative tributaries are summarized in Table WIL-3 (Billings RMP area), Table WIL-4 (Powder River RMP area), and Table WIL-5 (Park, Gallatin, and Blaine counties). The scientific names of fish species discussed in the following text are given in Tables WIL-3, WIL-4, and WIL-5.

Numerous other aquatic resources besides fish are present in emphasis area water bodies. These resources often are important in the diet of various species of fish, or they comprise part of the food web that fish ultimately depend on in their diet. Examples of other aquatic resources include benthic macroinvertebrates and microinvertebrates, zooplankton, phytoplankton, periphyton (attached algae), snails, clams, and worms. Numerous taxa of aquatic insects whose distribution and abundance vary with geographic location, habitat type, and habitat condition occur in planning area drainages. Immature and adult forms of Plecoptera (stoneflies), Ephemeroptera (mayflies), Trichoptera (caddisflies), and Diptera (true flies) are particularly important in the diets of juvenile and adult trout, whitefish, and other native fish species.

Fish and other aquatic species that have been listed, proposed, or are candidates for listing as federally endangered or threatened species, or have otherwise been designated as federal or state sensitive species or species of concern, are discussed under Special Status Species in this Aquatic Resources section.

Billings RMP Area

Major rivers and streams in the Billings RMP area are the Yellowstone River and its tributaries in the southern two-thirds of the area, and the Musselshell River and its tributaries in the northern one-third of the area. Both of these rivers eventually drain to the Missouri River outside of the RMP area. Major tributaries to the Yellowstone River are the Boulder, Stillwater, Clarks Fork of the Yellowstone, and Bighorn rivers. Careless Creek is a major tributary to the Musselshell River. Each of the referenced drainages is characterized by a dendritic pattern of tributaries, with flows ranging from perennial to ephemeral (MBOGC 1989). Examples of other water bodies that provide important habitat for aquatic resources in this resource management plan are Bighorn Lake, Cooney Reservoir, Big Lake, Lebo Lake, numerous mountain lakes at higher elevations, and miscellaneous water bodies such as storage reservoirs and stock ponds.

The Billings RMP area drainages listed in Table WIL-2 have been characterized as ranging from “national renown” in the more upstream reaches to “stream and area fair” in some of the downstream reaches (Montana NRIS 2001). Designated fisheries management in these drainages is for trout, except in the Yellowstone River east of Billings (managed for warm/cool water and non-trout species) and in the downstream section of the Clarks Fork of the Yellowstone (managed for non-trout species) (see Table WIL-2). The fisheries resource value in these drainages is outstanding, high, or substantial, except in the Little Bighorn River (moderate value) and Careless Creek (moderate or limited value in some reaches). The greatest numbers of fish species are generally found in the more downstream reaches of larger drainages, with comparatively fewer species present in the more upstream, or upstream reaches of, tributaries. Numbers of fish species present vary from 32 in the Musselshell River, 28 in the Yellowstone River east of Billings, 20 in the Yellowstone River west of Billings, 9 in the Boulder and Stillwater rivers, and 8 in the Little Bighorn River (see Table WIL-2).

Table WIL-3 provides detail about the relative abundance of fish species collected from each of the Billings RMP area drainages listed in Table WIL-2. Many of the same fish species are abundant or common in many of these drainages, although there is a pattern, proceeding downstream, of increased species diversity and the replacement of predominantly cold-water species by cool and warm water species. Examples of abundant or commonly occurring game fish in the Yellowstone River west of Billings are rainbow trout, brown trout, mountain whitefish, and burbot (ling); abundant or common non-game fish species in this reach of the Yellowstone River include, among others, goldeye, longnose sucker, white sucker, mountain sucker, shorthead redhorse, and mottled sculpin (see Table WIL-3).

The same species of trout and whitefish, as well as Yellowstone cutthroat trout and brook trout, also are abundant or common in the Boulder and Stillwater rivers. By comparison, these same species of salmonids are either uncommon in occurrence or absent from the mainstem Yellowstone River east of Billings. Instead, game fish typically associated with cool or warm water regimes—such as channel catfish, northern pike, smallmouth and largemouth bass, yellow perch, sauger, and walleye—first appear in river collections or are more abundant than farther upstream (see Table WIL-3).

Fish species present in the Clarks Fork of the Yellowstone and in the Bighorn River generally represent a subset of fish species present in nearby reaches of the Yellowstone River. There are more fish species present in the downstream sections of the Clarks Fork (19 species) and the Bighorn (30 species) than in their upstream sections (12 species in the Clarks Fork and 17 species in the Bighorn) (see Table WIL-2). Rainbow trout, brown trout, and mountain whitefish are present in both sections of the Clarks Fork and Bighorn rivers, but these species are more abundant in the upstream than downstream sections (see Table WIL-3). Yellowstone cutthroat trout also are present in the Clarks Fork, and Arctic grayling are present in the upstream section of the Clarks Fork. Other game species present in these two drainages include channel catfish, burbot, and sauger in the downstream section of the Clarks Fork, and channel catfish, northern pike, burbot, smallmouth bass, sauger, and walleye in both sections of the Bighorn River. The Little Bighorn River, which is tributary to the downstream section of the Bighorn River, supports five commonly occurring game fish species, including rainbow trout, brown trout, mountain whitefish, channel catfish, and smallmouth bass (see Table WIL-3).

A variety of 32 fish species are present in the Musselshell River within the Billings RMP area (Table WIL-2). More than half of these species have been rated as abundant or common in occurrence in various fisheries studies conducted on this drainage (see Table WIL-3) (Montana NRIS 2001). Examples of game species present in the Musselshell, which is managed as a trout fishery within the RMP area, include brown trout, mountain whitefish, channel catfish, black bullhead, northern pike, smallmouth bass, sauger, and walleye. Examples of dominant non-game species present in the Musselshell are goldeye, common carp, sand shiner, flathead chub, longnose dace, longnose sucker, white sucker, mountain sucker, shorthead redhorse, and mottled sculpin. The 10 species of fish present in Careless Creek, a tributary to the Musselshell, are dominated by non-game fish, such as lake chub, flathead chub, longnose dace, and white sucker. The only game fish reported from Careless Creek is brook trout, which is common in occurrence (see Table WIL-3).

Some of the storage reservoirs and stockponds in the Billings RMP area, and in other planning area reservoirs and stockponds, have been stocked with various game fish species. Examples include northern pike, largemouth bass, yellow perch, walleye, bluegill, crappie, and rainbow trout (MBOGC 1989, BLM 1995). Rainbow trout must be restocked regularly because they will not reproduce in ponds, but other species such as bass, perch, bluegill, and crappie may establish self-sustaining populations in ponds.

Water quality in perennial rivers and streams within the Billings RMP area is generally good. Water quality in the Yellowstone River has been rated as good for wildlife uses, while water quality in the Musselshell River has been rated as satisfactory for wildlife uses (BLM 1995). The BLM (1995) also reported that the area's semiarid climate is not conducive to maintaining fish habitat and populations in most intermittent streams. However, Regele and Stark (2000), citing the Montana Fish, Wildlife, and Parks (MFWP), stated that perennial as well as intermittent prairie streams in southeastern Montana are important in the life histories of native fish species and often provide spawning and rearing habitat for mainstem fish species.

Powder River RMP Area

Major rivers and streams that comprise important aquatic habitat in the Powder River RMP area are the Yellowstone River and its tributaries in the western two-thirds of the area, and the Little Missouri River and its tributaries in the eastern one-third of the area. All of these rivers eventually drain to the Missouri River outside of the RMP area. Major tributaries to the Yellowstone River are the Tongue (and Tongue River Reservoir), Little Powder, and Powder rivers, and Rosebud, Pumpkin, Otter, Armells, Hanging Woman, and Mizpah creeks. Box Elder Creek is a tributary to the Little Missouri River. The referenced drainages are characterized by a dendritic pattern of perennial and ephemeral tributaries (MBOGC 1989). Examples of other water bodies that provide habitat for aquatic resources in this RMP area are lakes, storage reservoirs, and stock ponds.

The Powder River RMP area drainages listed in Table WIL-2 have been characterized as typically ranging from "clean stream and natural setting" to "stream and area fair," although the Powder River varies from "natural and pristine beauty" in the upstream section to "low" in the downstream section (Montana NRIS 2001). Fisheries management in these drainages is for non-trout species, warm/cool water species, or has not been designated, except in the upstream section of the Tongue River where designated fisheries management is for trout. The fisheries resource value in most of these drainages is high, substantial, or moderate, except in some reaches of Pumpkin and Mizpah creeks that have limited fisheries resource value. The greatest numbers of fish species are generally found in the more downstream or downstream reaches of larger drainages, with fewer species present in the more upstream or upstream reaches of smaller tributaries. Numbers of fish species present vary from 40 in the Yellowstone River and 33 in the downstream section of the Tongue River to 13 in the Little Powder River and 18 in the Little Missouri River (see Table WIL-2).

Table WIL-4 provides detail on the relative abundance of fish species collected from many of the Powder River RMP area drainages listed in Table WIL-2. The number of fish species in this reach of the Yellowstone River (40 species) is considerably greater than in the Yellowstone within the Billings RMP area east of Billings (28 species) and west of Billings (20 species). The most abundant game fish in the Yellowstone River in the Powder River RMP area are shovelnose sturgeon, paddlefish, channel catfish, burbot, sauger, and walleye. Lesser numbers of a wide variety of other game species also are present, such as northern pike, various sunfishes, smallmouth and largemouth bass, white and black crappie, and rainbow and brown trout. Examples of some of the more abundant non-game species in the Yellowstone are goldeye, common carp, emerald shiner, flathead chub, river carpsucker, white sucker, shorthead redhorse, and stonecat. The federally listed endangered pallid sturgeon occurs rarely in the Yellowstone River within this RMP area (see Table WIL-4).

Species present in tributaries to the Yellowstone River within the Powder River RMP area generally overlap with those species present in the mainstem Yellowstone. However, species composition in the tributaries is less diverse overall, particularly in the smaller drainages and in the upstream sections of drainages (see Table WIL-4). Some of the fish species dominant in the Yellowstone also are prominent in sections of the Tongue and Powder rivers. Examples include shovelnose sturgeon, channel catfish, sauger, goldeye, common carp, flathead chub, white sucker, and shorthead redhorse. Other game species present in the Tongue and Powder rivers include northern pike, walleye, several species each of bullheads, sunfishes, and crappies in the Tongue River; burbot, green sunfish, and walleye in the Powder River; and rainbow and brown trout, which are uncommon in occurrence, in the upstream sections of the Tongue and Powder rivers (see Table WIL-4). Smallmouth bass, a popular cool water game fish, have been captured at various locations throughout the Tongue River, and are reported to be abundant in Tongue River Reservoir (Montana NRIS 2002).

Considerably fewer game species are present in the smaller Powder River RMP area tributaries listed in Table WIL-2. For the following tributaries, the only game species reported as common in occurrence are channel catfish, northern pike, burbot, and sauger in Rosebud Creek, which drains directly to the Yellowstone; channel catfish in Pumpkin Creek, which is tributary to the downstream section of the Tongue River; and channel catfish in the Little Powder River, which is tributary to the downstream section of the Powder River (Montana NRIS 2001) (see Table WIL-4). The Little Missouri River, which empties into the Missouri River and contains 18 fish species, supports four game species, including channel catfish, black bullhead, green sunfish, and sauger (see Table WIL-4).

Water quality conditions and concerns in perennial, intermittent, and ephemeral drainages in the Powder River RMP area are generally similar to those described for drainages in the Billings RMP area. Water quality in the Yellowstone and Powder rivers has been rated as good for wildlife uses (MBOGC 1989).

Elser et al. (1980) reported the results of extensive fisheries investigations conducted on numerous large and small drainages in southeastern Montana. The authors found that the lower Yellowstone River in this part of the state supports a diverse, productive fishery that is dependent on adequate flows and good water quality. Elser et al. (1980) reported that in the Tongue River, fish populations range from a cold water-mixed population downstream of the dam at Tongue River Reservoir to an assemblage of slow-water species downstream near the river's mouth. They added that migrant fish species from the Yellowstone River depend on high spring flows to allow good passage into the Tongue River. Elser et al. (1980) noted that fish populations in the Powder River are limited in diversity and abundance because of water quality and water quantity conditions. Fish populations are probably limited for similar reasons in the Little Missouri River, which Elser et al. (1980) described as having highly erratic flows, fair to poor water quality, very hard water, and moderate to high turbidities.

Park, Gallatin, and Blaine Counties

Various water bodies provide important aquatic habitat and sustain valuable fisheries in Park, Gallatin, and Blaine counties. Important habitat in Park County includes the Yellowstone River as it flows north from Yellowstone National Park, tributaries to the Yellowstone such as Shields River, and numerous mountain lakes. The Yellowstone River in Park County is of "national renown," is managed for its trout fishery, and has an outstanding fisheries resource value (see Table WIL-2). Shields River has been characterized as a "clean stream in a natural setting," is managed for its trout fishery, has a high to substantial fisheries resource value, but also is periodically dewatered (Montana NRIS 2001).

The Yellowstone River in Park County supports 12 species of fish. Yellowstone cutthroat trout, rainbow trout, brown trout, and mountain whitefish are the dominant game species, with longnose sucker, white sucker, longnose dace, and mottled sculpin among the dominant non-game species (see Table WIL-5). Shields River, with 10 fish species, generally supports the same assemblage of dominant cold-water game and non-game fish as the Yellowstone River. Water quality in the referenced Park County drainages, and in drainages in Gallatin and Blaine counties discussed in the following text, generally tends to be good to excellent, primarily because of the proximity to headwaters or the often undeveloped or remote nature of the surrounding areas.

Major drainages in Gallatin County include the Gallatin, Madison, and Jefferson rivers and their tributaries, which combine to form the Missouri River. These rivers and streams are managed for, and support, nationally renowned trout fisheries that have either an outstanding, high, or substantial fisheries resource value (see Table WIL-2). The Gallatin County drainages vary from “national renown” to “clean stream and natural setting.” However, periodic dewatering problems have been identified for portions of the Missouri and Gallatin rivers, and chronic dewatering problems have been identified for portions of the Jefferson and Gallatin rivers (Montana NRIS 2001).

The relative abundance and kinds of fish species present in the referenced Gallatin County drainages are similar, varying from 13 species in the Missouri and Madison rivers to 12 species in the Jefferson and Gallatin rivers. Dominant game fish include brown trout, rainbow trout, and mountain whitefish, with dominant non-game fish consisting of longnose sucker, white sucker, longnose dace, and mottled sculpin. Other less abundant cold-water game species present in some of these drainages include Yellowstone cutthroat trout, westslope cutthroat trout, brook trout, and Arctic grayling. Table WIL-5 provides further information on fish species present and their relative abundance in these drainages. In addition, sicklefin chub (*Macrhybopsis meeki)* occur in the Missouri River in Gallatin County. The FWS found that listing this species is not warranted, although significant concern for this species remains (FWS 2001).

Important aquatic habitat in Blaine County includes the Missouri River and its tributaries, such as Cow Creek, in the southern half of the county, as well as the Milk River and its tributaries, such as Lodge and Peoples creeks, in the northern half of the county. The Milk River empties into the Missouri River east of Blaine County. Examples of other water bodies that provide important aquatic habitat in Blaine County are North Chinook Reservoir and Putnam Lake. The Missouri River in Blaine County is of “national renown,” is managed as a non-trout fishery, and has an outstanding fisheries resource value (see Table WIL-2). Its tributaries in Blaine County have been characterized as of “clean stream and natural setting” or “stream and area fair,” and have a fisheries resource value of high, substantial, or moderate. Cow Creek and part of Peoples Creek are managed as trout fisheries, while the Milk River, Lodge Creek, and part of Peoples Creek are managed for non-trout species (Montana NRIS 2001).

The numbers of fish species present in Blaine County drainages listed in Table WIL-2 vary from 31 in the Milk River and 26 in the Missouri River to eight in Cow Creek (see Table WIL-5). Many of the same fish species are abundant or common in the Missouri and Milk rivers and are dominated by species with warm or cool water preferences. Examples include goldeye, common carp, emerald shiner, flathead chub, longnose dace, and stonecat. Examples of other commonly occurring species in these drainages include shovelnose sturgeon, western silvery/plains minnow, longnose sucker, channel catfish, and sauger in the Missouri River, and lake chub, northern redbelly/finescale dace, white sucker, burbot, yellow perch, sauger, and walleye in the Milk River. Sicklefin chub also occur in the Missouri River in Blaine County. Of the eight species present in Cow Creek, which is managed as a trout fishery, only brook trout occur in abundance. Examples of commonly occurring species in Lodge and Peoples creeks include: lake chub, common carp, fathead minnow, black bullhead, northern pike, and yellow perch in Lodge Creek; longnose dace, redside shiner, brook trout, and mottled sculpin in Peoples Creek; and white sucker and western silvery/plains minnow in both creeks. The federally listed endangered pallid sturgeon occurs rarely in the Missouri River within Blaine County (see Table WIL-5).

Special Status Species

Many federally listed threatened, endangered, or candidate species of special concern exist in the planning area that are given special consideration under Section 7(c) of the ESA of 1973. As required by the ESA, the FWS has provided a list of endangered, threatened, and proposed species that may be present in the planning area. This section reviews the habitat requirements of the three special status aquatic species identified by the FWS (see Table 3-37), as well as the likelihood of them being found in the 16 counties that may be potentially affected by this project.

TABLE 3-37
SPECIAL STATUS AQUATIC SPECIES PRESENT IN THE CBM EMPHASIS AREA

Common Name	Scientific Name	Habitat in Montana	Federal Status*
Fish			
Montana Arctic grayling	*Thymallus arcticus*	Fluvial populations in the cold-water, mountain reaches of the Upper Missouri River	C
Pallid sturgeon	*Scaphirhynchus albus*	Bottom dwelling fish of the Missouri and Yellowstone rivers	E
Invertebrates			
Warm spring zaitzevian riffle beetle	*Zaitzevia thermae*	Warm springs in Gallatin County	C

*E = Endangered; C = Candidate.

Montana Arctic Grayling

This species is a candidate for listing under the ESA. On October 2, 1991, a petition requested that the “fluvial Arctic grayling” be listed as an endangered species throughout its historic range in the lower 48 states. The petitioners stated that the decline of the fluvial Arctic grayling was a result of many factors, including habitat degradation as a result of the effects of domestic livestock grazing and stream diversions for irrigation, competition with nonnative trout species, and past overharvesting by anglers.

Additionally, the petition stated that much of the annual recruitment is lost in irrigation ditches. Historically, this species was widely, but irregularly, distributed and locally abundant above Great Falls in the upper Missouri River drainage in Montana (FWS 1994c).

Pallid Sturgeon

This species was listed as endangered on September 6, 1990 (55 FR 36641). They evolved in large rivers with high turbidity and a natural hydrograph consisting of spring flooding and other natural highwater events. Historically in Montana, they occupied reaches of the Missouri River from Fort Benton downstream and in the Yellowstone River from Miles City to the Missouri River (FWS 1993). There are three priority recovery management areas in Montana, two on reaches of the Missouri and one on the Yellowstone River.

Warm Spring Zaitzevian Riffle Beetle

This species is a candidate for listing. This species is only known to inhabit a single warm springs in Gallatin County near the City of Bozeman.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

MONTANA

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter presents the environmental impacts from management actions described in Chapter 2. The descriptions of predicted effects that would result from the exploration, construction, operation and maintenance, and abandonment activities associated with coal bed methane (CBM) for each alternative is compared to the pre-project environment.

Chapter 4 contains an *Introduction, Analysis Assumptions and Guidelines* section, and individual Resource Topic discussions. Table 2-3, in Chapter 2, summarizes and compares the impacts of the alternatives. The *Introduction* outlines the chapter and provides an explanation of the organization and creation of assumptions. The *Analysis Assumptions and Guidelines* section presents the Reasonably Foreseeable Development scenario (RFD) used to predict the level of CBM development and addresses the analysis assumptions common to all alternatives. The Resource Topic discussions are organized alphabetically. Under each resource topic, the following are addressed: assumptions, impacts from management common to all alternatives, and impacts from management specific to each alternative.

The duration of the impacts are analyzed and described as either short-term (up to 5 years) or long-term (greater than 5 years). Impacts from management of conventional oil and gas are found in the *Impacts From Management Common to All Alternatives* sections. Impacts from management of CBM are found in the *Impacts From Management Specific to Each Alternative* sections.

The narrative describing the impacts from management specific to each alternative includes subsections summarizing the impacts to the Crow and Northern Cheyenne Tribes, mitigation measures and a conclusions summary. The conclusion summarizes the cumulative impacts from other regional ongoing and foreseen projects.

Cumulative impacts consider the alternative in combination with other substantial existing and future developments in and near the CBM emphasis area, including oil and gas development projects, existing and future coal mines, new power plants, and effects from Wyoming's CBM development. Project descriptions for activities considered in the cumulative impacts analysis are presented in the Minerals Appendix under Oil and Gas. Mitigation measures that are not already included as part of the alternative or alternatives are described and evaluated, and the residual impacts are determined.

The resource discussions also address the differences between U.S. Bureau of Land Management (BLM) and State of Montana (state) impacts where divisions are meaningful. Physical impacts on landscapes from development disturbances can easily be quantified for BLM and state regulated wells; however, effects on watersheds or wildlife from both BLM and state development cannot easily be distinguished and therefore are discussed in conjunction.

Analysis Assumptions and Guidelines

Analysis assumptions and guidelines provide common data to environmental impact statement (EIS) team members to use when conducting the impact assessments for each resource. The assumptions and guidelines are based on previous events, experience of personnel, and their knowledge of the resources in the planning area. The assumptions include the demand for various resources, the ability of the resources to meet the demand, and how the actions will be carried out. An RFD was developed for this purpose and is discussed in the following sections.

Potential for Development—Reasonably Foreseeable Development Scenario

The RFD addresses potential development on all lands, including the Crow and Northern Cheyenne Indian reservations and the Ashland Ranger District of the U.S.

What has Changed in Chapter 4 Since the Draft EIS?

Chapter 4 describes the impacts of the alternatives in each of the resource areas. As described in Chapter 2, public comment on the Draft EIS resulted in additional mitigation measures for Alternative E—Preferred Alternative. These additional mitigation measures were evaluated by resource area specialists and the impact analysis was altered in some cases in this alternative. The Air Quality and Hydrology sections had additional changes, based on the improved data used, as text throughout the chapter was revised for simpler presentation. These changes were described in Chapter 3.

Forest Service (USFS). The RFD is in no way stating that the BLM or the State of Montana are making decisions for Indian lands or the USFS administered lands. For example, the decision to develop CBM on Indian lands will be made by the Indian allottees, and the tribes with concurrence of the Bureau of Indian Affairs (BIA), not by BLM or the state.

The presumption of possible impacts to the environment is based on BLM guidance (BLM H-1624-1) provided for estimating the potential for oil and gas resources and for extrapolating the degree of development that is reasonably foreseeable over a given period of time. In the case of Montana's Powder River Basin and additional areas of emphasis, it is the level of CBM development most likely to occur over the next 20-year period. The RFD is located in the Minerals Appendix, under "Reasonably Foreseeable Development Scenario." The following sections contain explanations of 1) the potential for CBM resources within the emphasis area boundaries, and 2) RFD for the different detailed development scenarios that are addressed by the various alternatives in this EIS.

Potential for CBM Resources

An estimate of CBM and conventional oil and gas resources was accomplished using many sources of information, including established files and databases, the BLM Resource Management Plans (RMPs) for the areas, coal information from the U.S. Geological Survey (USGS), professional and academic literature, available oil and gas maps, previous mineral assessments and expressions of interest, and projections from the oil and gas industry. To project CBM exploration and development, the areal extent of certain coals and the rank of coals in the CBM emphasis area were considered.

Areas of subbituminous to bituminous coals were considered as the most likely to be explored and developed in Montana, although exploration and development has occurred mainly in subbituminous coal in the Wyoming portion of the Powder River Basin. The USGS produced a Open File Report (OF 96-92) showing the areas of coal, by rank, for the United States. This information indicates subbituminous and bituminous coals in many parts of the emphasis area. See Map MIN-1 in the Minerals Appendix for an illustration of this data and Map 4-1 for a geographical presentation of potential CBM development within Montana.

Powder River, Rosebud, Custer, and Big Horn counties contain the northern part of the basin, which extends from Wyoming. Blaine and Musselshell counties have mostly subbituminous coal. Carbon County has an extension of the Big Horn Basin coal, which is ranked as bituminous coal. Gallatin and Park counties have scattered areas of bituminous to subbituminous coals.

The amount of methane gas that could be produced from the coal beds in Montana has been projected to range from a low of 1 trillion cubic feet (TCF) (Crockett and Meyer 2001) to a high of 17.7 TCF (Nelson 2000). This and other information for Montana is used to predict where CBM exploration is most likely to occur in the emphasis area. The RFD predicts the number of CBM wells that would be drilled and completed during the next 20 years per alternative. By making these predictions, cumulative impacts can be assessed.

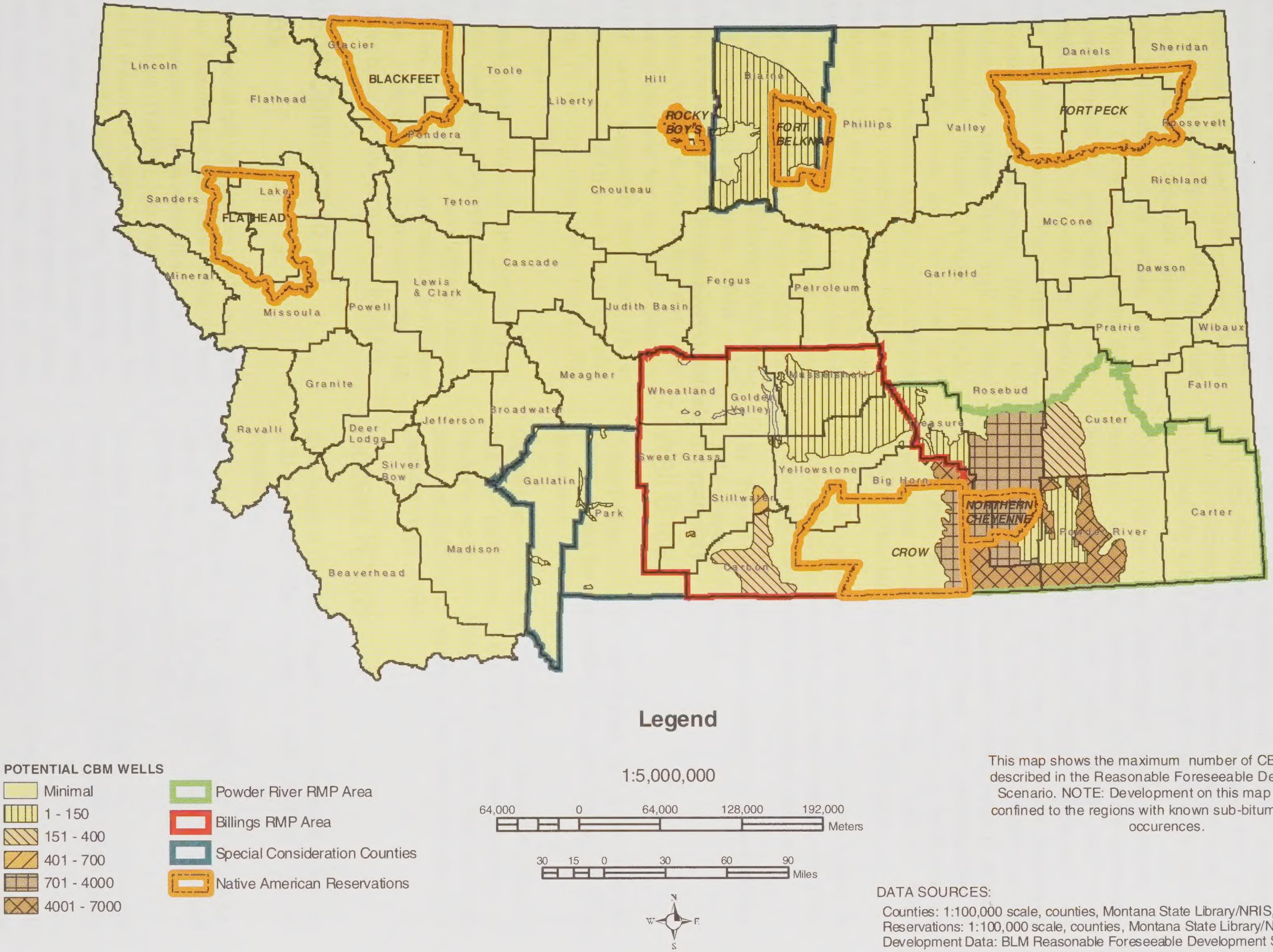
Reasonably Foreseeable Development Scenario

Projections of future CBM development and production are difficult to make. Several variables complicate such forecasts, including new exploration, development or production techniques; increases or decreases in demand for natural gas; and price increases or decreases that may prompt larger or smaller development and production programs. For this EIS, a combination of historical trends, present activity, government and industry estimates, and professional judgments were used in establishing the estimate of RFD. The RFD is discussed under two scenarios: restricted development and expanded development.

Restricted Development (Current Management)

Restricted development is applied to Alternative A. Under this scenario, the BLM would only approve exploration well permits and the state would only proceed with the development identified in the Stipulation and Settlement Agreement as presented in Chapter 2. With regards to the BLM exploration wells, an RFD of 200 wells per RMP area was assigned to provide a level of quantification for analysis; however, the BLM has no actual upper cap on issuing exploration well permits. The RFD number in no way represents a regulatory number for exploration wells that could be issued by the BLM. The 400 BLM exploration wells, combined with the state's limited development, results in a total of 675 exploration wells and 250 production wells assumed under Alternative A.

Map 4-1: CBM Development Based on Reasonably Foreseeable Development Scenario


Lincoln
Glacier
BLACKFEET
Toole
Liberty
Hill
Blaine
Phillips
Valley
Daniels
Sheridan
FORT PECK
Roosevelt
Flathead
Pondera
ROCKY BOY'S
FORT BELKNAP
Sanders
Lake
FLATHEAD
Teton
Chouteau
Richland
McCone
Mineral
Missoula
Powell
Lewis & Clark
Cascade
Judith Basin
Fergus
Petroleum
Garfield
Dawson
Prairie
Wibaux
Granite
Meagher
Wheatland
Golden Valley
Musselshell
Rosebud
Fallon
Ravalli
Deer Lodge
Jefferson
Broadwater
Treasure
Custer
Silver Bow
Gallatin
Sweet Grass
Yellowstone
Big Horn
Stillwater
NORTHERN CHEYENNE
Park
Madison
CROW
Powder River
Carter
Carbon
Beaverhead
Legend
POTENTIAL CBM WELLS
Minimal
1 - 150
151 - 400
401 - 700
701 - 4000
4001 - 7000
Powder River RMP Area
Billings RMP Area
Special Consideration Counties
Native American Reservations
1:5,000,000
64,000
0
64,000
128,000
192,000
Meters
30
15
0
30
60
90
Miles
N
W
E
S

This map shows the maximum number of CBM wells as described in the Reasonable Foreseeable Development Scenario. NOTE: Development on this map has been confined to the regions with known sub-bituminous coal occurences.

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Development Data: BLM Reasonable Foreseeable Development Scenario.

This page left blank intentionally.

Expanded Development

Expanded development is considered for Alternatives B, C, D, and E. Expanded refers to the number of potential wells based on known coal volumes that would be drilled in the CBM emphasis area during the next 20 years, regardless of mineral ownership. Given the current oil and gas stipulations, the restricted development areas, and the unknown geographical distribution of coal bed methane, it is unlikely that the maximum well density of 1 well per producing coal seam per 80 acres would be achieved. Map 4-1 indicates the predicted number of wells per county overlying known coal occurrences. The estimate for expanded development ranges from 10,000 to 26,000 wells drilled, the upper limit includes the Reasonably Foreseeable Future Action (RFFA) estimates of 4,000 wells each for the Crow and Northern Cheyenne reservations and 200 wells for the Custer National Forest. The Powder River RMP area could host as many as 7,500 to 14,000 producing CBM wells during the next 20 years. The RFD also estimated that between 200 to 800 new conventional oil and gas wells could be drilled in the Powder River RMP area during the same time period. In the Billings RMP area, an estimated 1,000 to 2,400 producing CBM wells could be installed. Conventional oil and gas wells are estimated to increase by 250 to 975 during this same time. The expanded estimate for the three counties outside the RMP areas suggested that from 18 to 50 CBM wells could be drilled (Blaine 3 to 10, Gallatin 5 to 15, and Park 10 to 25), along with 150 to 500 conventional oil and gas wells.

The expanded development estimate also predicted the number of potential field and sales compressors needed to export the gas. This level of development would require from 400 to 1,000 field compressors and from 50 to 100 sales compressors. Estimates for the gathering and sales lines are also included in the RFD.

Assumptions Common to All Alternatives

Assumptions common to all alternatives address issues such as level of disturbance associated with various development scenarios, implementation of best management practices (BMPs), general assumptions for percentages of alternative themes and numbers for various field equipment utilized, well spacing for production of CBM, and water discharge and drawdown rates for expanded development. These assumptions are used to ground the analysis so that similar comparisons can be conducted across the various resource topics and throughout the alternatives.

Levels of Disturbance

In evaluating environmental impacts, criteria for determining quantitative impacts are required. Further, to facilitate some uniformity with respect to impact analyses, the following synopsis was prepared to give a general understanding of the resources necessary for the installation and production of a single CBM well.

These values were determined from a variety of sources, including previous CBM Environmental Assessments, discussions with BLM and state personnel, discussions with CBM operators, and information derived from the review of numerous applicable documents. However, actual references are not provided as these numbers were ultimately derived through internal analysis based on understanding of current and proposed CBM activities in Montana and other areas (including Wyoming, Colorado, New Mexico, Arkansas, Alabama, and Oklahoma).

The values presented in Table 4-1 can be scaled to accommodate the various scenarios being proposed for exploration, construction and operation phases.

The following descriptions outline the assumptions used to develop Table 4-1.

Well Sites

Construction = 0.25 acre based on a 105-foot by 105-foot pad for exploration, construction and drilling operations

Operations = 0.058 acre based on a 50-foot by 50-foot pad for operations, well pad size may increase if multiple wells are drilled on the same pad, but total acres of disturbance would be less than separate well pads for single wells

Access Roads

Two-track = 0.30 acre based on 12-foot-wide roads by 0.21 mile/well (this applies to both construction and operation)

Graveled Roads = 0.11 acre based on 12-foot-wide roads by 0.075 mile/well (this applies to both construction and operation)

Bladed Roads = 0.075 acre based on 12-foot-wide roads by 0.05 mile/well (this is for construction phase only)

Bladed Roads = 0.090 acre based on 12-foot-wide roads by 0.06 mile/well (this is for operation phase only)

TABLE 4-1
LEVEL OF DISTURBANCE

Facilities		Exploratory Well Disturbance (acres/well)	Construction Disturbance (acres/well)	Operation/Production Disturbance (acres/well)
Well Sites		0.25	0.25	0.05
Access Roads/ Routes to Well Sites	Two-track	N/A	0.30	0.30
	Graveled	N/A	0.10	0.10
	Bladed	0.75	0.075	0.10
Utility Lines	Water	N/A	0.35	----[1]
	Overhead Elec.	N/A	0.20	0.20
	Underground Elec.	N/A	0.35	----
Transportation Lines	Low Pres. Gas	N/A	0.90	----
	Intermediate Pres. Gas	N/A	0.25	----
Processing Area	Battery Site	N/A	0.020	0.020
	Access Roads	N/A	0.15	0.15
	Field Compressor *1/24 producing wells*	N/A	----	(0.5/24) = 0.02
	Sales Compressor *1/10 Field Compressors*	N/A	----	(1.0/240) = 0.005
	[2]Plastic Line	N/A	----	0.5
	Gathering Line	N/A	----	0.25
	Sales Line	N/A	----	0.075
Produced Water Management	Discharge Point	N/A	0.01	0.002
	Storage Impoundment	N/A	0.3	0.25
Total Disturbance		1.0	3.25	2.0

Note: This table shows levels of disturbance associated with exploration and development of CBM wells and field transfer equipment. All values represent acres per well unless otherwise noted.

[1] All utilities are completed underground and the land above is reclaimed so the acres of disturbance are removed from the operation column. **Note:** The intent of reclamation is to stabilize the area of disturbance and establish a vegetative cover similar to the native plant community that existed prior to disturbance. Reclamation success will vary as described in the *Vegetation* section.

[2] Lines within processing area are assumed to disturb an average width of 25 feet.

Bladed Roads = 0.75 acre based on 12-foot-wide roads by 0.5 mile/well (this is for exploration only)

Utility Lines

Water = 0.35 acre based on 15-foot by 0.20 mile/well (construction only)

Elec. Utility Overhead = 0.20 acre based on 10-foot by 0.15 mile/well (construction and operation)

Elec. Utility Underground = 0.35 acre based on 15-foot by 0.20 mile/well (construction only)

Transportation Lines

Low Pressure Gas = 0.90 acre based on 15-foot by 0.5 mile/well (construction only)

Intermediate Pressure Gas = 0.25 acre based on 25-foot by 0.08 mile/well (construction only)

Battery Site

Construction and Operation = 0.5 acre per battery site. Assume one battery site per field compressor. Disturbance per well = (0.5/24) = 0.020

Access Roads = 0.15 acre based on 25-foot by 0.050 mile/well during construction and operations

Field Compressors = 1 compressor/24 producing wells

Sales Compressors = 1 compressor/240 producing wells or 10 field compressors

Plastic line = 0.5 mile/well pad. Assume 3 wells per pad, 25-foot width

Gathering line = 2.0 miles/field compressor at 25-foot width or (5280*2*25/24/43,560) = 0.25 acre/well

Sales line = 6.0 miles/sales compressor at 25-foot wide. (6*5280*25/240/43,560) = 0.075 acre/well

Produced Water Management

Assume 1 discharge point for every 20 wells

Discharge points construction = 0.01 acre/point based on 20-foot by 20-foot area during construction

Discharge points operations = 0.002 acre/point based on 10-foot by 10-foot area during operations

Storage impoundments = 6 acres/impoundment during construction per well pod of 20 wells, assume one acre reclaimed from construction so 5 acres/impoundment during operation per pod of 20 wells

The actual disturbance per well will be dependent on the actual site specific water management practices used.

Total Area of Disturbance

Exploration = 1.0 acres/well

Construction = 3.25 acres/well

Operation = 2.0 acres/well

Field Rules and Leasing Stipulations

The discussion of impacts assumes that the leasing stipulations described for each resource would be successfully implemented in each of the alternatives regardless of land ownership or management classes to which they apply. Existing Lease Stipulations and mitigation measures (see Minerals Appendix, Table MIN-5) are considered to be standard operating procedures by BLM. The Montana Board of Oil and Gas Conservation (MBOGC) implements restrictions analogous to stipulations through the issuance of field rules. Field rules are applied on a case-by-case basis to protect resources on state land and private land. The MBOGC reviews each operator's development plan and then issues field rules.

The MBOGC will provide guidance to private landowners if requested on how and what to include in their leases to protect resources, but it is up to the individual lessor as to what they request from the operator in terms of reclamation, mitigation, and other measures. The Montana Trust Land Management Division (TLMD) of the Montana Department of Natural Resources and Conservation (DNRC) also has lease stipulations for their minerals as listed in the Minerals Appendix. The TLMD utilizes a set of standard stipulations on all oil and gas leases that is different from those used by BLM. Additional stipulations are placed on the leases on a case-by-case basis prior to their being leased. In addition, the TLMD undertakes a site-specific review process for exploration and operating plan proposals. This review process generates site-specific stipulations for issues such as steep topography, wildlife, streams, wooded areas, and rivers and lakes. It was assumed that only requirements contained in existing federal and state law that apply to private land ownership will be enforced on private land.

Stipulations and field rules are intended to avoid potential effects on resource values and land uses from oil and gas activities and include actions such as site clearances and occupancy and timing restrictions.

Lease stipulations would be implemented before conducting exploration, production, and abandonment activities. The following discussion of project impacts assumes that applicable stipulations and field rules would be fully implemented and followed. The success of these stipulations or field rules in avoiding covered impacts, in some instances, will require collection of site specific information regarding the resources to be protected relative to exploration, production, and abandonment plans followed by strict adherence to the terms of the stipulations and field rules. Planned monitoring activities by the BLM for all resources have been outlined in a table attached in the Monitoring Appendix. Impacts described include those that would occur in spite of the successful implementation of stipulations or field rules, or where stipulations or field rules are not expected to avoid all impacts.

Proposed mitigation measures are intended to minimize the impacts that cannot be avoided. Mitigation measures also apply to all alternatives on BLM and state lands. Residual impacts are those expected to remain after the implementation of mitigation measures.

General Assumptions

Assumptions represent the best professional judgment of the specialist based on experience, similar occurrences and known circumstances, and studies. Assumptions that are common to all of the alternatives provide the foundation for the analysis of impacts. The following assumptions apply to each alternative:

- The spacing for CBM wells would be similar to CBM well spacing in Wyoming with one well per 80 acres per coal seam. Up to three coal seams have been identified for possible methane extraction in the Powder River Basin. This would result in three wells drilled per 80-acre spacing unit.
- The life of a typical CBM production well is assumed to be 20 years.
- CBM wells will come on line and go off line as described in the RFD.
- Water production for a single CBM well can be estimated by the following equation:

  $$Q = 14661e^{-0.0242t}$$

  Where Q = discharge in gpm and t = time in months. The average production over 20 years using this equation is 2.5 gpm, however discharge rates would begin at approximately 15 gpm and decrease over time as the coal seam becomes dewatered.
- The combination of the 2 preceding assumptions results in the maximum discharge for the total field occurring in year 6 of the development, when 7,095 well would be pumping at an average rate of 6.2 gpm to produce 43,989 gpm. This maximum produced water volume is used for the impact analysis.
- 20% of waters discharged water will evaporate or infiltrate prior to perennial waters being impacted.
- It is assumed that a single CBM well will drain the methane from a single coal seam over an 80-acre unit. Research by the BLM in the Wyoming portion of the Powder River Basin suggests that drainage may be across a broader radius (Crockett and Meyer 2001). Drainage issues will need to be assessed on a case-by-case basis to determine the drainage radius, which will depend upon local reservoir parameters.
- The level of disturbance associated with a production well is the same regardless of the method of completion, whether a single well bore per coal seam or multiple seam completions in a well bore.
- Typical drilling operations for each CBM well, regardless of whether it was a CBM exploration or production well, would require 3 to 5 days with an additional 2 to 3 days for completion work. A maximum of 7 to 8 people would be present on a well at any one time during this construction phase.
- Approximately 26,000 gallons of water would be needed to drill each well. The water will be obtained from the local river, streams, wells, or reservoirs trucked into remote sites as needed.
- Equipment present at each well site during construction would consist of the following: one or two truck-mounted drill rig(s), with three men per rig; one backhoe; one blade; three crew pick-up trucks; one well logging truck; one pipe truck; two to four water trucks; one cement truck; one electrical generator trailer; one frac tank for wastewater; and two large flat bed trailers. Not all vehicles would be at the well site at the same time or for the entire duration of drilling and completion operations.
- Portable toilets would be available at the drill sites. Garbage would be stored in closed containers.

Sewage and solid waste would be hauled offsite to permitted disposal facilities.

- Each CBM well would be equipped with a submersible pump ranging from 3 to 20 horsepower, depending on well depth and other site conditions.
- Exploration wells would be visited once a day during testing and pumping operations. Pump tests could last as long as 6 months depending on the time required for measuring cumulative methane production estimates. Methane would be flared (burned off) continuously during the testing phase.
- Fuel for generators during exploration testing would be either gas (propane) or diesel and require at least one trip to the well site weekly. Small generators used during testing would be mobile, enclosed, and between 15 to 20 kilowatts (kW).
- A larger generator used during production would serve several wells (three to four) and be in the range of 75 to 125 kW.
- The proposed preferred alternative (Alternative 2A) for the Wyoming Powder River Basin oil and gas projects will be implemented under all alternatives. This alternative assumes continued development of CBM and conventional oil and gas resources would occur in the Wyoming Powder River Basin planning area. Up to 39,367 additional CBM wells and 3,200 conventional oil and gas wells would be developed over the next 10 years.
- Under Alternatives B, C, and D, the number of exploration/dry holes would be approximately 10 percent of the total estimated wells drilled. Furthermore, all exploration/dry holes would be drilled in the first 5 years of development.
- Under Alternatives A and C, the number of wells connected to each compressor would be per operators plans; it is assumed that this is consistent with the RFD of 24 wells per compressor. This estimate is based on an average well production rate of 250,000 cubic feet per day methane being sent to a 6 million cubic feet per day, four-stage reciprocal compressor operating at 380 horsepower and using natural gas.
- Under Alternatives B and D, the number of wells connected to each compressor would be maximized; this is assumed to be approximately 35 wells at average production going to a 9 million cubic feet per day, four-stage reciprocal compressor. The maximization of well connections would reduce the number of field compressor sites and air emissions.
- No hydraulic fracturing or cavitation would be required to stimulate wells; however, low-pressure, low-volume water enhancement may be used. This would involve flushing the well with a few hundred gallons of water to clean the face of coal surface in the exposed seam. This process does not fracture the coal; it simply cleans out the existing fractures.
- Under Alternatives B and D in the theme of CBM, multiple completions in a single borehole would be required. It is assumed that a small reduction in surface disturbance would be experienced, but that the levels of disturbance previously described are acceptable for these alternatives without alteration.
- Under Lands and Realty, when no transportation corridors are required, it is assumed that the utility lines (power, water, and gas) would be placed along separate routes, or in existing disturbances to and from the well site locations or compressor batteries, whichever is more suitable to the operator. When transportation corridors are required, it is assumed that they would be placed adjacent to access roads and along existing disturbances, resulting in a 35 percent reduction of disturbed surface areas.
- Concerning Socioeconomics it is assumed that the state would not enforce buffer zones on their minerals or on private minerals since they do not have a trust responsibility.
- The potential development on the reservations would be considered under the cumulative effects analysis based on the development outline in the RFD for the reservations.
- Under the Hydrology theme for Alternative B, untreated CBM water from exploration wells would be placed in tanks and disposed of at a permitted injection well. It is assumed that the use of pits, impoundments, and other holding facilities as permitted under Alternative A would be allowed. In addition, it is assumed produced water would be injected into a deeper aquifer of lesser quality with no communication to aquifers used as sources of drinking water or into coal seam aquifers.
- Under the Hydrology theme for Alternatives C and D, produced water would be available for beneficial use. It is assumed that industries and landowners would use approximately 20 percent of the produced water. The estimate of 20 percent is

based on the observed beneficial uses at the CX Ranch, and in Wyoming and on the perceived potential for similar uses throughout the emphasis area.

On August 23, 2002, U.S. District Judge Sam E. Haddon ruled that unaltered ground water discharged as a result of coal bed methane development is not a "pollutant" as that term is defined in the federal Clean Water Act (CWA). Since the court found that unaltered ground water is not a pollutant under the CWA, the court went on to hold that discharges from coal bed methane development do not require permits under the federal NPDES permit program (*Northern Plains Resource Council v. Redstone Gas Partners,* CV 00-105-BLG-SHE, District of Montana, Billings Division). In its ruling, the court explained that its holding applied with equal force to Montana's MPDES permit requirements. This decision is currently being appealed.

In response to this ruling, the DEQ is in the process of developing rules that, if approved by the Board of Environmental Review, would require proposed discharges from coal bed methane development to be reviewed by the DEQ to ensure compliance with state water quality standards. The rules would clarify DEQ's authority to impose limits or conditions on discharges of coal bed methane to ensure that all water quality standards, including the state's nondegradation requirements, will be met.

Through this process the anticipated impacts to surface waters from CBM activities would be similar if the Haddon decision is upheld or if CBM discharges are subject to permitting under the MPDES program. For the sake of analysis it is assumed in this document that CBM discharges are subject to MPDES requirements, however if this is not the case, the anticipated impacts would be similar, but the permitting process would change.

Assumption Rationale

CBM Well Production Life

The rationale for using a 20-year lifespan for a typical CBM well in Montana is based on several technical considerations as well as the best professional judgment of several specialists. The well life is based on the economic limit selected for the well, the wide variety of geologic basins in Montana, the data limitations, the variations in the rank of coals that may be encountered in Montana, and a review of the well life of CBM wells in other producing basins, including Wyoming and the San Juan Basin. These rationale are generally summarized below:

Montana Planning Area: The planning area for the Montana document is the Billings and Powder River RMPs for BLM and statewide with emphasis on the BLM planning area, plus Blaine, Park, and Gallatin counties for the state. Although an emphasis was placed on the Powder River Basin, assumptions used were derived for the entire planning area based on existing available information. CBM production in Montana and Wyoming is relatively new as compared to conventional oil and gas production in either of these states. In Montana, only approximately 250 producing CBM wells exist in a very small area near Decker, Montana. Throughout Montana, very little information is available relative to CBM production or testing outside of the current producing area at CX Ranch. Further, there are a variety of underground coal seams that must be considered, including areas in the Powder River Basin, Bull Mountain Basin, Park County, Gallatin County, Blaine County, and areas elsewhere in the state (including the entirety of the two BLM RMPs).

1. **Economic Production Limits on CBM Wells**: The BLM in Wyoming selected an average production life for CBM wells in the planning area based on production decline analysis from existing production on federal leases. These analyses assume an economic limit of approximately 1,000 MCF per month (personal communication, Bob Chase, BLM). CBM producers currently operating in the Wyoming Powder River Basin suggested the economic limit of 1,000 MCF per month to the BLM. Based on Wyoming's limited planning area and the extent of existing data available that is directly within the planning area, this approach appears justified. To date, no wells have been confirmed as reaching their economic limit in the Powder River Basin in either Wyoming or Montana. Several wells have reached monthly production of less than 1,000 MCF per month and several other wells have been shut-in. However, based on existing knowledge of CBM operations, it is not clear whether shut-in wells will remain shut-in without further production.

   The economic limits used by the Wyoming BLM of 1,000 MCF per month appear reasonable for planning in the Wyoming portion of the basin. However, there are many examples of wells producing at rates of less than 1,000 MCF per month for considerable periods. The Wyoming portion of the Powder River Basin has production rates less than 1,000 MCF while continuing to produce. However, it is currently unknown whether CBM wells in the Montana Powder River Basin will be shut-in and plugged once a production rate of 1,000 MCF per month is achieved.

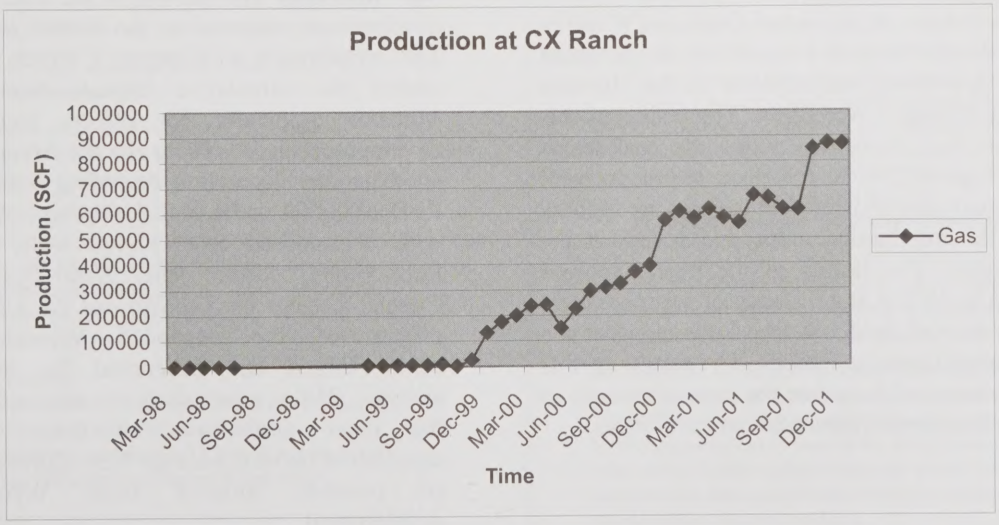
Of further consideration is the rationale that the proposed economic production limit used in the Wyoming EIS is based on certain economics provided by operators currently producing in Wyoming. Many of these producers are relatively large businesses. In the case of conventional oil and gas production, it is common for larger producers to sell production to smaller companies that may be capable of operating projects at a lesser cost—especially later in the life of the project when production rates are substantially reduced. This progression of producing properties transitioning from large companies to smaller companies supports the argument that the viable economic production life of a CBM well could be less than 1,000 MCF per month. This is especially significant considering the socioeconomic situation in Montana and especially relative to the Northern Cheyenne and Crow Indian reservations.

2. **Geologic Differences**: Because the Montana planning area includes the entire state, there are significant differences in geology when comparing assumptions used for impact analyses between the two plans.

3. **Data Limitations**: CBM production in Montana and Wyoming is relatively new as compared to conventional oil and gas production in either of these states. In Montana, only approximately 250 producing CBM wells exist in a very small area near Decker, Montana. Throughout Montana, very little information is available relative to CBM production or testing outside of one current producing area at CX Ranch. Further, there are a variety of underground coal seams that must be considered, including areas in the Powder River Basin, Bull Mountain Basin, Park County, Gallatin County, Blaine County, and areas elsewhere in the state (including the entirety of the two BLM RMPs). Figure 4-1 presents production data for the CX Ranch field near Decker, Montana (MBOGC 2001b). This figure shows that actual production of CBM in Montana started in April 1999.

4. **Variations in Rank of Coal**: Coals in the Powder River Basin are all of Tertiary age throughout both Montana and Wyoming. However, the Montana planning area includes coals that are much older and of higher rank. For instance, the coal seams near Bozeman Pass and Great Falls are of Cretaceous age and have an overall higher rank than Powder River Basin coals. This suggests that these coals may contain methane that is more thermogenic in nature than biogenic. Although there is not any existing production data for areas other than the CX Ranch in Montana, it is reasonable to assume that CBM wells in these areas may produce economic quantities of methane for longer durations than in the Powder River Basin without the benefit of historical production data. In certain situations, where multiple coal beds are present, a well's productive life can be extended by reworking the well to produce gas from deeper coal beds. For example, well completions in multiple coal beds could extend the life of a well site by 10 to 30 years.

FIGURE 4- 1
PRODUCTION AT THE CX RANCH



Studies of CBM wells in the San Juan Basin, which produce from greater depths than CBM wells in the PRB, have projected CBM gas production for 20 years. The deeper coal in other basins of Montana may produce in a similar fashion and have a well life of 20 years.

Differences in Produced Water Sodium Absorption Rate (SAR) and Electrical Conductivity (EC) Values

These differences are based on differences that exist across the basin. These differences are based on geologic and the available produced water data for each state. The geologic differences relate to how the coal seams change northward across the basin. In Wyoming, the coals seams are thicker (averaging up to 250 feet or more in aggregate thickness in many areas) and more continuous, northward in the basin into Montana, the coal seams thin (generally less than 100 aggregate feet) and become locally discontinuous.

In Montana there is a limited data set with little to no data outside the CX Ranch, which was used as the basis for the SAR and EC values in the DEIS. The produced water data available for the Montana Powder River Basin indicates there are significant differences in water quality in the northern part of the basin in comparison to the Wyoming portion of the Powder River Basin. The water quality data available for Montana varies enough from Wyoming that using the Wyoming data for impact analysis in Montana would underestimate the potential impacts in Montana.

Maximum Drawdown in Coal-Seam Aquifers

The Montana Bureau of Mines and Geology (Wheaton and Metesh 2002) released a report on the potential groundwater drawdown and recovery in the Montana portion of the Powder River Basin. The results of this report indicate that drawdown within the coal seams could be as high as 240 to 600 feet within the well field. The report also indicated drawdown as high as 300 feet in the interburden units, and 6 feet in the overburden units. The results of the model showed drawdown up to 30 feet at a distance of approximately 2 miles from the well field and drawdown of 5 feet at a distance of approximately 7 miles. The results of this model have been used to update the impact analysis in the Final Environmental Impact Statement (FEIS).

Decrease Flow in Surface Water

In the Montana portion of the Powder River Basin, the bulk of the coals of the Fort Union Formation are confined to the Tongue River Member, while the Lebo and Tullock Members are predominantly shale and shaley sand (McLellan et al. 1990). Because of the confined nature of the coals and lack of the Wasatch Formation in Montana, the production of CBM water is not expected to result in decreases to surface water base flows. There are also several potential increases to flow that may mask any potential decreases in surface water flow. The discharge of CBM-produced water to the ground surface and surface waters would mask any reduction in flow in the surface waters.

Beneficial Use of CBM Production Water

The Montana EIS preparation team assumes that 20 percent of the produced water will be available for beneficial purposes in Alternatives C and D. Under the Preferred CBM Development Alternative (E) it is assumed that emphasizing beneficial uses combined with increased flexibility for water management practices should result in an increase in beneficial water usage. The beneficial uses envisioned are based on current practices, such as livestock watering, creation of wildlife watering areas (Environmental News Network 2001), coal mine dust suppression (Fidelity 2001), irrigation, constructed wetlands (Davis 1995), domestic water supply, produced water as drilling fluid (Clark and Hemler 1992), de-icing of road aggregate storage piles (DeWalle and Geleone 1990), and enhancement of fisheries and riparian zones (Wyoming Game and Fish Department, n.d.).

Wyoming RFD Impacts

The Montana EIS accounts for the full scale of development proposed by the current Wyoming RFD. The introduction to Chapter 4 directs the reader to review the cumulative impacts discussion in the Minerals Appendix for effects from the CBM development in Wyoming. In the Minerals Appendix an expanded discussion regarding both the Wyodak RFD of 6,000 wells and the current Wyoming RFD with a proposed new 39,400 wells is addressed. Furthermore, within the *Hydrology* section of Chapter 4 under the *Conclusions for Alternative A* the effects of the expanded Wyoming RFD is acknowledged and accounted for in the impact analysis. These conclusions are also referenced under the other alternatives conclusion sections for cumulative impacts because they address the full range of possible impacts from Wyoming CBM development.

Resource Topics

Air Quality and Climate

Air Quality

Existing air quality throughout most of the analysis area is in attainment with all ambient air quality standards. However, three areas have been designated as federal nonattainment areas where the applicable standards have been violated in the past: Lame Deer (PM_{10}—moderate) and Laurel (SO_2—primary), Montana; and Sheridan, Wyoming (PM_{10}—moderate).

Impacts based on modeling show potential impacts only that would be mitigated through project level permitting.

Alternative A
No Action (Existing CBM Management)

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations would be below applicable state and National Ambient Air Quality Standards and PSD increments for near-field and far-field modeling.
- Potential direct impact on visibility within one mandatory federal PSD Class I, one Class II Area and the Class II Crow IR.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} NAAQS and PSD Class II increments south of Spring Creek Mine.
  - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation.
  - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area.
  - Potential visibility impacts in 10 of 17 federal PSD Class I including the Crow and Fort Peck Indian Reservations. Additional visibility impacts to 7 of 13 PSD Class II sensitive areas including the Crow and Fort Belknap Indian Reservations.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.
- Potential direct visibility impacts within seven mandatory federal PSD Class I Areas and the Northern Cheyenne Reservation. Additional visibility impacts to seven federal PSD Class II areas including the Crow and Fort Belknap Indian Reservations and three Wilderness Areas and one National Recreation Area and one National Monument.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine.
  - Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine.
  - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA.
  - Potentially exceed PSD Class I increments for annual NO_2 on the Northern Cheyenne Reservation.
  - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and Florence Lake in the Class II Cloud Peak Wilderness Area.
  - Potential visibility impacts in all federal PSD Class I and II sensitive areas including the N. Cheyenne, Fort Peck, Fort Belknap and Crow Indian Reservations.

Alternative C
Emphasize CBM Development

- Impacts under Alternative C are expected to be comparable to those describe for Alternative B but somewhat increased in severity due to the lack of control over operators choose for compressor fuel, reduced limits on compressor hook ups and the lack of enforceable control measures.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.
- Potential direct visibility impacts within one mandatory federal PSD Class I Areas. Additional visibility impacts to three PSD Class II areas including the Crow Indian Reservation, one Wilderness Area and one National Recreation Area.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine.
  - Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine.
  - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA.
  - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area.
  - Potential visibility impacts in 14 of 17 federal PSD Class I and all Class II sensitive areas including the N. Cheyenne, Fort Peck, Fort Belknap and Crow Indian Reservations.

Alternative E
Preferred CBM Development Alternative

- Impacts modeled for Alternative E would be comparable to those describe for Alternative B but are somewhat decreased in severity due to the use of gas-fired compressors and maximized compressor hook ups.
- Although the air quality modeling shows the potential for certain standards to be exceeded, these impacts would not occur. The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies and therefore, residual impacts would remain within standards.

Although the CBM development (project sources) and non-project sources emit carbon dioxide and methane, climate impacts are anticipated to be small from implementation of any of the alternatives. Climate impacts may even be beneficial to the extent that:

- Development of the CBM resource reduces the natural emissions of methane from coal mines
- Use of CBM displaces combustion of coal or oil, both of which emit more carbon dioxide than methane per unit energy produced.

Potential impacts to air quality are summarized in this section. A more complete summary of the modeled potential air quality impacts are given in the Air Quality Modeling Appendix with a highly detailed description of the air quality modeling given in Argonne 2002.

Issues, Impact Types, and Criteria

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (i.e., well operations, field and sales compressor engines, etc.), are potential causes of air quality impacts. These issues are more likely to generate public concern where natural gas development activities occur near residential areas. The Federal Land Managers (FLM), including the U.S. Department of Agriculture (USDA), U.S. Forest Service (USFS); the U.S. Department of Interior (USDI), National Park Service (NPS); and the USDI, U.S. Fish & Wildlife Service (FWS), have also expressed concerns regarding potential atmospheric deposition (acid rain) and visibility impacts within PSD Class I and PSD Class II areas under their administration, located throughout Montana, Wyoming, southwestern North Dakota, western South Dakota, northwestern Nebraska, and southeastern Idaho.

Air pollution impacts are limited by local, state, tribal and federal air quality regulations, standards, and implementation plans established under the Clean Air Act (CAA) and administered by the Montana Department of Environmental Quality—Air and Waste Management Bureau (MDEQ) and the EPA. Although not applicable to the proposed Alternatives, the Wyoming Department of Environmental Quality—Air Quality Division (WYDEQ) has similar jurisdiction over potential air pollutant emission sources in Wyoming, which can have a cumulative impact with MDEQ approved sources. Air quality regulations require certain proposed new, or modified existing, air pollutant emission sources (including CBM compression facilities) to undergo a permitting review before their construction can begin. Therefore, the applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees and control devices, prior to construction and/or operation.

In addition, the U.S. Congress (through the CAA Section 116) authorized local, state, and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than federal requirements. Site-specific air quality analysis would be performed, and additional emission control measures, including a best available control technology (BACT) analysis and determination, may be required by the applicable air quality regulatory agencies to ensure protection of air quality resources. Also, under the Federal Land Policy and Management Act (FLPMA) and the CAA, BLM cannot (and would not) authorize any activity that does not conform to all applicable local, state, tribal, and federal air quality laws, regulations, standards, and implementation plans.

The significance criteria for potential air quality impacts include local, state, tribal, and federally enforced legal requirements to ensure air pollutant concentrations would remain within specific allowable levels. These requirements include the National and Montana Ambient Air Quality Standards, which set maximum limits for several air pollutants, and PSD increments, which limit the incremental increase of NO_2, SO_2, and PM_{10} concentrations above legally defined baseline levels. These legal limits were presented in Chapter 3. Where legal limits have not been established, the BLM uses the best available scientific information to identify thresholds of significant adverse impacts. Thresholds have been identified for hazardous air pollutant (HAP) exposure, potential atmospheric deposition impacts to sensitive lake water chemistry, and a "just noticeable change" in potential visibility impacts.

An extensive air quality modeling technical support document was prepared by Argonne National Laboratory (Argonne 2002), and is summarized in the Air Quality Modeling Appendix. This technical report is available for review (contact information is given in the Air Quality Appendix). Argonne modeled potential changes in air quality from individual Alternatives A, B, C, D, and E, non-project emission sources, and all sources cumulatively by alternative. Since Alternatives B, C, and E have similar emission inventories, a single air quality analysis represents all three alternatives.

The air quality modeling was based on the best available engineering data and assumptions, meteorology data, and dispersion modeling procedures, as well as professional and scientific judgment.

Due to the broad nature of this analysis, it should be considered a reasonable estimate of predicted impacts. Actual impacts at the time of project level development (subject to air pollutant emission source permitting) are likely to be less.

The EPA CALPUFF dispersion model was used with meteorological data generated by the MM5 (mesoscale model) and CALMET models. Meteorological information was assembled to characterize atmospheric transport and dispersion from several 1996 data sources, including the following:

1) 36 km gridded MM5 (mesoscale model) values with continuous four-dimensional data assimilation
2) Hourly surface observations (wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity, and precipitation)
3) Twice-daily upper air vertical profiles (wind speed, wind direction, temperature, and pressure)
4) PRISM-adjusted hourly precipitation measurements

Potential air pollutant emissions from the alternatives' emission sources (denoted as project sources) were calculated separately to determine potential impacts. These emissions were then combined with existing sources, proposed non-Powder River Basin Oil and Gas developments, and reasonably foreseeable future actions (RFFA) emissions (denoted as "non-project" sources), and RFFA emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest to determine the total potential cumulative air quality impacts. All of the tables in this analysis and the Air Quality Modeling Appendix display modeled emmissions from the following:

1) The project sources only
2) The project sources combined with emissions from potential CBM development on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest (denoted as "Project + RFFA Sources)
3) The non-project sources
4) Cumulative totals

The non-project sources include development permitted by the following agencies and states: 1) MDEQ; 2) WYDEQ; and 3) within the states of North Dakota, South Dakota, and Nebraska; and projections for the Wyoming Powder River Basin Oil and Gas Project DEIS Alternative sources (BLM 2002a); and other RFFA sources from states within the geographic area covered by the model.

Table 4-2 shows total emissions from the non-project (permitted and other RFFA sources), Wyoming Powder River Basin Oil and Gas project sources, and Montana Powder River Basin Oil and Gas project sources combined with RFFA sources. (Note that these emissions are for Alternatives B, C, and E; Alternative A and D emissions would be lower and the potential CBM wells on the Northern Cheyenne and Crow Indian Reservations and the Ashland District of the Custer National Forest have been included with the emissions for Alternatives B, C, and E.)

The meteorology data and air pollutant emission values were combined to predict maximum potential direct, indirect, and cumulative near-field air quality impacts in the vicinity of assumed well and compressor engine emission sources for comparison with applicable air quality standards and PSD Class II increments. Maximum potential near-field particulate matter emissions from traffic on unpaved roads and during well pad and compressor station construction were used to predict the maximum annual and 24-hour average SO_2, $PM_{2.5}$, and PM_{10} impacts. Maximum air pollutant emissions from each CBM well would be temporary (i.e., occurring during a 12-day construction period) and would occur in isolation, without significantly interacting with adjacent well locations. Particulate matter emissions from well pad, compressor station and resource road construction would be minimized by application of water and/or chemical dust suppressants. The control efficiency of these dust suppressants was computed at 50 percent during construction. During well completion testing, natural gas could be burned (flared) on a single day.

Air pollutant dispersion modeling was also performed to quantify potential PM (particulate matter), CO, NO_2, and HAP impacts during operation. Operation emissions would primarily occur due to increased compression requirements, including field and sales compressor stations. Since produced natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, direct VOC emissions are not likely. HAP impacts were predicted based on an assumed, six-unit, 1,650-horsepower each, reciprocating compressor engine station operating at full load with emissions generated by a single stack.

TABLE 4-2
NON-PROJECT AND PROJECT TOTAL EMISSIONS SUMMARY

Source Category	Annual Emissions (tons/year)					
	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO	VOCs
Non-Project Sources (2006)						
DM&E Sources	14,391	3,655	722	263	799	294
CDWII Sources	1,269	563	257	---	---	---
Wyoming Sources	7,250	1,773	2,691	1,028	13,505	2,795
Montana Sources	3,169	950	2,279	1,003	2,576	880
Nebraska & N. Dakota Sources	1,114	26	102	48	449	132
New Sources Subtotal	27,192	6,966	6,051	2,343	17,329	4,101
Montana RFFA Sources	2,844	4,796	127	71	6,171	20
Wyoming RFFA Sources	1,578	3,381	298	155	3,381	--
South Dakota RFFA Sources	289	35	53	53	175	71
Other RFFA Sources Subtotal	4,710	8,212	478	279	9,277	91
Wyoming Alternative 1 Project Sources (w/Project Year noted)	**17,834** (Yr 5)	**829** (Yr 3)	**2,918** (Yr 6)	**1,280** (Yr 5)	**14,799** (Yr 5)	**8,268** (Yr 5)
Total Non-Project Sources	**49,737**	**16,007**	**9,447**	**3,902**	**41,855**	**12.460**
Montana Alt. B, C, and E Project + RFFA Sources (w/Project Year noted)	**9,959** (Yr 18)	**339** (Yr 5)	**1,230** (Yr 5)	**514** (Yr 15)	**9,378** (Yr 20)	**4,841** (Yr 20)

DM&E – Dakota, Minnesota and Eastern Railway Corporation

CDWII – Continental Divide/Wamsutter II and South Baggs Natural Gas Development Projects

The EPA CALPUFF dispersion model was also used to determine maximum far-field ambient air quality impacts at downwind mandatory federal PSD Class I areas, and other sensitive receptors, to accomplish the following:

1) Determine if the PSD Class I increments might be exceeded
2) Calculate potential total sulfur and nitrogen deposition, and their related potential impacts to sensitive lakes
3) Predict potential visibility impacts (regional haze) within distant sensitive receptors

The NEPA analysis compares potential air quality impacts from the proposed alternatives to applicable ambient air quality standards and PSD increments, but comparisons to the PSD Class I and II increments are intended to evaluate a threshold of concern for potential impacts, and do not represent a regulatory PSD Increment Consumption Analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. The Montana DEQ will perform the required regulatory PSD increment analysis during the new sources review process. This formal regulatory process will include analysis of impacts on Class I and II air quality areas by existing and proposed emission sources. The activities are not allowed to cause incremental effects greater than the stringent Class I thresholds to occur inside any PSD Class I Area. Stringent emission controls (BACT – Best Available Control Technology) and emission limits may be stipulated in air quality permits as a result of this review, or a permit could be denied.

Several lakes within five USFS-designated wilderness areas were identified as being sensitive to atmospheric deposition and for which the most recent and complete data have been collected. The USFS (Fox et al, 1989) has identified the following total deposition (wet plus dry) thresholds below which no adverse impacts to air-quality related values (AQRVs) are likely: 5 kilograms per hectare per year (kg/ha-yr) for sulfur, and 3 kg/ha-yr for nitrogen. The USFS Rocky Mountain Region has also developed a screening method (USFS 2000) which identifies the following Limit of Acceptable Change regarding potential changes in lake chemistry: no more than a 10 percent change in acid neutralizing capacity (ANC) for those water bodies where the existing ANC is at or above 25 microequivalents per liter (μeq/l) and no more than a 1 μeq/l change for those extremely sensitive water bodies where the existing ANC is below 25 μeq/l. No sensitive lakes were identified by either the NPS or FWS.

Since the proposed Alternative and cumulative air pollutant emission sources constitute many small sources spread out over a very large area, discrete visible plumes are not likely to impact the distant sensitive areas, but the potential for cumulative visibility impacts (increased regional haze) is a concern. Regional haze degradation is caused by fine particles and gases scattering and absorbing light.

Potential changes to regional haze are calculated in terms of number of days with greater than a perceptible "just noticeable change" (1.0 deciview, or dv) in visibility when compared to background conditions. A 1.0 dv change is considered potentially significant in mandatory federal PSD Class I areas as described in the EPA Regional Haze Regulations (40 CFR 51.300 *et seq.*), and originally presented in Pitchford and Malm (1994). A 1.0 dv change is defined as about a 10 percent change in the extinction coefficient (corresponding) to a 2 to 5 percent change in contrast, for a black target against a clear sky, at the most optically sensitive distance from an observer). This is a small but noticeable change in haziness under most circumstances when viewing scenes in mandatory federal Class I areas. However, the perceptibility threshold can be smaller or larger than this value depending on viewing conditions.

For example, a 1.0 dv change is not a "just noticeable change" in all cases for all scenes. Visibility changes less than 1.0 dv are likely to be perceptible in some cases, especially where the scene being viewed is highly sensitive to small amounts of pollution, such as a site with preferential forward light scattering. Under other view-specific conditions, such as where the sight path to a scenic feature is less than the maximum visual range, a change greater than 1.0 dv might be required to be a "just noticeable change."

This NEPA analysis is not designed to be a regulatory analysis conducted to Federal Land Manager specifications nor is the analysis designed to predict specific visibility impacts for specific views in specific mandatory federal PSD Class I areas based on specific project designs. Rather, it is to characterize reasonably foreseeable visibility conditions that are representative of a fairly broad geographic region, based on multiple assumptions regarding project and non-project source emissions. This approach is consistent with both the nature of regional haze and the requirements of NEPA. The modeling was conducted to identify areas that may require more detailed consideration when specific project-level permits are issued for CBM development. At the time of a preconstruction air quality permit application, the applicable air quality regulatory agency may require a much more detailed visibility impact analysis. Factors such as the magnitude of dv change, frequency, time of the year, and the meteorological conditions during times when predicted visibility impacts are above the 1.0 dv threshold should all be considered when identifying areas for scrutinizing at the project-permitting level.

The USFS, NPS, and FWS have published their Final FLAG Phase I Report (Federal Register, Vol. 66 No. 2, dated January 3, 2001), providing a consistent and predictable process for assessing the impacts of new and existing sources on AQRVs including visibility. For example, the FLAG report states, "A cumulative effects analysis of new growth (defined as all PSD increment-consuming sources) on visibility impairment should be performed," and further, "If the visibility impairment from the proposed action, in combination with cumulative new source growth, is less than a change in extinction of 10 percent [1.0 dv] for all time periods, the FLMs will not likely object to the proposed action."

Air Quality Modeling Assumptions: Near-field impacts refer to receptor points less than 50 km from the emissions source; far-field impacts are greater than 50 km from the source. When reviewing the modeled near- and far-field results, it is important to understand the assumptions made regarding potential resource development. In developing this analysis, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations) and so actual impacts may vary from the modeled values and would be affected by project permit conditions or stipulations. The modeling was based on the following assumptions:

- Total predicted short-term air pollutant concentrations were assumed to be the sum of the assumed background concentration, plus the predicted maximum cumulative modeled concentrations, which may occur under different meteorological conditions.
- Background air pollution concentrations were assumed to occur throughout the 20-year life of project at all locations in the region; even though this background was derived from monitoring primarily conducted in urban or industrial areas, rather than rural areas. The uniform background PM_{10} levels for each state are assumed to be representative of the background conditions for the entire modeled area of the PRB, based on monitoring data gathered throughout northeastern Wyoming and southeastern Montana.
- The maximum predicted air quality impacts occur only in the vicinity of the anticipated emission sources. Actual impacts would likely be less at distances beyond the predicted points of maximum impact.
- All emission sources were assumed to operate at their reasonably foreseeable maximum emission rates simultaneously throughout the life of project. Given the number of sources included in this analysis, the co-probability of such a scenario actually occurring over an entire year is small.
- In developing the emissions inventory and model, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations, etc.) Most (90 percent) proposed CBM wells and 30 percent of conventional wells were assumed to be fully operational and remain operating (no shut ins) throughout the life of project.
- The total proposed booster (field) and pipeline (sales) compression engines were assumed to operate at their rated capacities continuously throughout the life of project (no phased increases or reductions). In actual developments, compression equipment is expected to be added or removed incrementally as required by the well field operation, compressor engines would operate below full horsepower ratings, and all compressor stations would not be operating at maximum levels simultaneously.
- The HAP analyses assumed a 9,900 horsepower, six-unit, reciprocating compressor engine station would operate at full load and at maximum emission levels continuously throughout the life of project.
- The emissions inventory and model use peak years of construction and peak years of operations, which would not occur throughout the entire development region at the same time. However, these conditions may occur in some areas.
- The emissions inventory and model assumed that an emission rate for compressor engines of 1.5 g/hp-hr of NO_x. Since BACT is decided on a case-by-case basis, actual emission rates could be decided to be less or more than this level by the Departments of Environmental Quality in Wyoming or Montana, and on Indian lands by EPA, for field and sales compressor engines. Actual NO_x emission rates may range from 0.7 to 2 g/hp-hr.
- There are no applicable local, state, tribal or federal acid deposition standards. In the absence of applicable standards, the acid deposition analysis assumed that a "limit of acceptable change is: a 10 percent change in ANC for lakes with a background ANC greater than 25 μeq/l; or a 1 μeq/l change in ANC for lakes with a background ANC less than 25 μeq/l, and would be a reasonably foreseeable significant adverse impact. Further, the atmospheric deposition impact analysis assumed no other ecosystem components would affect lake chemistry for a full year (assuming no chemical buffering due to interaction with vegetation or soil materials).
- The visibility impact analysis assumed that a 1.0 dv "just noticeable change" would be a reasonably foreseeable significant adverse impact, although there are no applicable local, state, tribal or federal regulatory visibility standards. However, some FLMs are using 0.5 dv as a screening threshold for significance.
- Mitigation measures are included in the emissions inventory and model that may not be achievable in all circumstances. However, actual mitigation decided by the developers and local and state authorities may be greater or less than those assumed in the analysis. For example, maintaining a construction road speed limit of 15 mph may be reasonable in a construction zone but difficult to enforce elsewhere. Full (100 percent) mitigation of fugitive dust from disturbed lands may not be achievable. Further, 50 percent reduction in fugitive emissions is assumed based on construction road wetting on the unimproved access road to the pad and at the pad, but this level

of effectiveness is characterized as the maximum possible. In the air quality modeling, no specific road wetting or other emissions were assumed to be used during the operations phase of the development (e.g., for maintenance vehicle traffic). However, during the review of proposed projects (Applications for Permit to Drill) the BLM would require specific mitigation measures in certain areas during the operational phase of development.

- Induced or secondary growth related to increases in vehicle miles traveled (VMT) (believed to be on the order of 10 percent overall) is not included in the emissions inventory and model. Not all fugitive dust emissions (including county and other collector roads) have been included in the emissions inventory and model.
- Fugitive dust emissions from roads are treated as area sources rather than line sources in the model, which may thereby reduce or increase the predicted ambient concentrations at maximum concentration receptor points near the source, depending on the inputs to the model (meteorology, terrain, etc.) By not placing modeled receptors close to emission sources (e.g. wells and roads), the model may not capture higher ambient concentrations near these sources. A more refined, regulatory model may yield higher concentrations at locations near fugitive dust sources.
- For comparisons to the PSD Class I and II increments, the emissions inventory and model included only CBM and RFFA sources. Other existing increment consuming sources such as Campbell County coal mines were not included in this comparison, as the air quality analysis does not represent a regulatory PSD increment consumption analysis. A regulatory PSD increment consumption analysis needs to identify and consider all PSD increment consuming sources to determine the level of PSD Class II increment consumption. Monitoring data in Wyoming has indicated an upward trend in PM concentrations in Campbell County since 1999, which coincides with CBM development but is also exacerbated by prolonged drought in the region.

Given these assumptions, the model represents an estimate of potential air quality impacts in the project area and region.

It is important to note that before actual development could occur, the applicable air quality regulatory agencies (including the state, tribe, or EPA) would review specific air pollutant emissions preconstruction permit applications that examine potential project-wide air quality impacts for some categories of sources. As part of these permits (depending on source size), the air quality regulatory agencies could require additional air quality impacts analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality. Emission sources that would violate standards would not be permitted.

Impacts from Management Common to All Alternatives

Air quality impacts would occur during construction (due to surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well testing, and drilling rig and vehicle engine exhaust) and production (including well production equipment and field and sales compression engine exhausts), as well as emissions associated with secondary growth. The amount of air pollutant emissions during construction and production would be controlled by watering; applying chemical stabilizers, surface material or reseeded vegetation to disturbed soils; and by air pollutant emission limitations imposed by applicable oil and gas lease management agencies and air quality regulatory agencies. Actual air quality impacts depend on the amount, duration, location, and characteristics of potential emissions sources, as well as meteorological conditions (wind speed and direction, precipitation, etc.).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Impacts to air quality would be minimal under this alternative. Based on air quality modeling of potential near-field (direct, indirect, and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2, and PM_{10} concentrations could occur, but most maximum concentrations are expected to be below applicable state and National Ambient Air Quality Standards (NAAQS), as well as NAAQS PSD increments, as shown in Table 4-3. These results are for near-field modeling. Far-field modeling results were also found to be below NAAQS and PSD Increments.

Alternative A project source emissions would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 0.65 percent which equates to an 0.04 μeq/l change. This is below threshold level of 1.0 μeq/l.

Direct visibility impacts from Alternative A project source emissions are predicted to be limited to the Class II, Crow Indian Reservation. Up to 2 days annually were predicted to have a greater than "just noticeable change based on Alternative A project source emissions only. The Alternative A sources are predicted to have no direct impact on visibility in the other Class I and Class II areas (as shown in Table 4-6, under the "Project Sources Only" column.)

Cumulative Impacts

Given the extensive non-project emission sources located throughout the analysis region (including CBM developments in the Wyoming section of the Powder River Basin), there is a potential for cumulative air quality impacts from Alternative A project sources and non-project sources to exceed applicable thresholds under Alternative A. Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 104 μg/m^3 for 24-hour PM_{10}. When combined with the assumed background level of 105 μg/m^3, the total impact of 210 μg/m^3 would exceed the 24-hour PM_{10} NAAQS of 150 μg/m^3. Note that the Alternative A project sources contribute a maximum of 1.8 μg/m^3, as shown in Table 4-4. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location.

TABLE 4-3
ALTERNATIVE A—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact (μg/m^3)	PSD Increments[a] (μg/m^3) Class II	Montana Background (μg/m^3)	Total Impact[b] (μg/m^3)	Montana AAQS (μg/m^3)	NAAQS (μg/m^3)
NO_2	Annual	1.94	25	11	12.9	100	100
	1-hour	20.6	n/a	117	138	566	n/a
SO_2	Annual	0.27	20	16	16	60	80
	24-hour	0.87	91	73	74	260	365
	3-hour	1.54	512	291	293	n/a	1,300
	1-hour	1.86	n/a	666	668	1,300	n/a
PM_{10}	Annual	0.52	17	30	31	50	50
	24-hour	1.83	30	105	107	150	150
$PM_{2.5}$	Annual	0.27	n/a	8	8	15	15
	24-hour	0.97	n/a	20	21	65	65
CO	8-hour	29.78	n/a	6,600	6,630	10,000	10,000
	1-hour	49.4	n/a	15,000	15,049	26,000	40,000

[a] PSD Increment is to be compared to the Project Modeled Impact .
[b] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

Therefore the sum of the individual contributions will not always equal the cumulative totals.)

In addition, non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Indian Reservation, as well as the PSD Class II increment, near the maximum assumed development area (see Table 4-5). For the Northern Cheyenne Indian Reservation the far-field analysis indicated a maximum increment level of 8.7 μg/m^3 with the non-project sources contributing 8.4 μg/m^3 and the Alternative A project sources contributing up to 0.5 μg/m^3.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 μeq/l), the predicted cumulative impact of 1.6 μeq/l change would exceed the threshold level of 1.0 μeq/l. Approximately 2.5 percent of this change would be attributable to Alternative A project sources alone. It should be noted that the very low background ANC level is based on only four samples taken on 3 days between 1997 and 2000.

Potential visibility impacts were predicted to occur from non-project sources alone in every sensitive area analyzed (see Table 4-6). The Alternative A project sources in themselves were predicted to have a negligible direct impact on these areas (exception is the Class II Crow IR). However, the cumulative analysis predicted an average daily visibility impact increase of approximately 1 day per year for some Class I sensitive areas. Of the 15 mandatory federal PSD Class I areas analyzed, cumulative average annual impacts would occur at the Fitzpatrick

TABLE 4-4
ALTERNATIVE A POTENTIAL NAAQS/MAAQS EXCEEDANCES

Location	Pollutant	Contributions (μg/m^3)				Cumulative Total	NAAQS/ MAAQS
		Project Sources Only	Project + RFFA Sources	Non-Project Sources	Back-ground		
Near-Field	PM_{10} 24-hr	1.8	n/a	104	105	210	150/150

TABLE 4-5
ALTERNATIVE A POTENTIAL PSD INCREMENTS EXCEEDANCES

Location	Pollutant	Contributions (μg/m^3)				PSD Class I Increment	PSD Class II Increment
		Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total		
N. Cheyenne IR	PM_{10} 24-hr	0.5	n/a	8.4	8.7	8	
Near-Field	PM_{10} 24-hr	1.8	n/a	104	105		30

TABLE 4-6
ALTERNATIVE A CLASS I AREA POTENTIAL VISIBILITY IMPACTS

	Contributions Visibility (No. of days >1.0dv/yr				
Location	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	Maximum Δdv[1]
Badlands WA	0	n/a	17 to 25	18 to25	10.0
Bridger WA	0	n/a	8 to 10	8 to 10	10.9
Fitzpatrick WA	0	n/a	7 to 9	8 to 10	13.5
Fort Peck IR	0	n/a	1 to 2	2 to 2	6.0
Gates of the Mountains WA	0	n/a	3 to 4	3 to 4	12.7
Grand Teton NP	0	n/a	4 to 6	4 to 6	5.8
N. Absaroka WA	0	n/a	10 to 12	11 to 12	11.3
N. Cheyenne IR	0	n/a	30 to 38	33 to 42	39.9
Red Rock Lakes WA	0	n/a	0 to 1	0 to 1	2.3
Scapegoat WA	0	n/a	2 to 2	2 to 3	8.2
Teton WA	0	n/a	7 to 9	7 to 10	11.9
Theodore Roosevelt NP (N. Unit)	0	n/a	1 to 2	1 to 2	3.3
Theodore Roosevelt NP (S. Unit)	0	n/a	2 to 4	2 to 4	3.9
U.L. Bend WA	0	n/a	5 to 5	5 to 6	23.7
Washakie WA	0	n/a	11 to 14	12 to 15	20.
Wind Cave NP	0	n/a	21 to 27	22 to 28	7.7
Yellowstone NP	0	n/a	9 to 11	9 to 11	9.0

[1] Δdv – change in deciview

Wilderness Area (up to 10 days per year); the Scapegoat Wilderness Area (up to 3 days per year); the Teton Wilderness Area (up to 10 days per year); the Washakie Wilderness Area (up to 15 days per year); and Wind Cave National Park (up to 28 days per year).

Up to 42 days annually were predicted to have a greater than "just noticeable change" within the redesignated PSD Class I Northern Cheyenne Indian Reservation based on cumulative impact. The Alternative A project sources are predicted to have no direct impact on visibility whereas the non-project sources are predicted to have an impact of up to 38 days annually.

The maximum potential cumulative visibility impacts (see Table 4-7) predicted at the PSD Class II Crow Indian Reservation were 69 days per year with Alternative A project sources directly contributing up to 2 days per year and non-project sources contributing up to 61 days per year. Fewer cumulative impacts were predicted at other PSD Class II sensitive receptors, including the Absaroka-Beartooth Wilderness Area (30 days per year), the Bighorn Canyon National Recreation Area (23 days per year), the Cloud Peak

Wilderness Area (30 days per year), Devils Tower National Monument (39 days per year), and Jewel Cave National Monument (32 days per year). The Alternative A project sources contributed generally 1 to 2 days per year to these cumulative totals. Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

Crow Reservation

Given the proximity of proposed Alternative A emission sources near or on the Crow Indian Reservation, it is understandable that several of the maximum air pollutant impacts would occur on tribal lands. All direct, indirect, and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Indian Reservation: up to 2 days per year from Alternative A project sources directly; up to 61 days per year from non-project sources; and up to 69 days per year from all sources cumulatively.

TABLE 4-7
ALTERNATIVE A CLASS

	Contributions Visibility (No. of days >1.0dv/yr)				
Location	**Project Sources Only**	**Project + RFFA Sources**	**Non-Project Sources**	**Cumulative Total**	**Maximum Δdv**
Absaroka Beartooth WA	0	n/a	28 to 29	28 to 30	15.2
Agate Fossils Bed NM	0	n/a	10 to 15	10 to 15	10.4
Bighorn Canyon NRA	0	n/a	19 to 21	19 to 23	28.2
Black Elk WA	0	n/a	20 to 26	20 to 26	8.4
Cloud Peak WA	0	n/a	21 to 28	23 to 30	13.9
Crow IR	2	n/a	56 to 61	65 to 69	53.0
Devils Tower NM	0	n/a	24 to 38	26 to 39	9.7
Fort Belknap IR	0	n/a	60 to 61	61 to 61	23.6
Fort Laramie NHS	0	n/a	13 to 17	13 to 17	14.4
Jewel Cave NM	0	n/a	24 to 31	24 to 32	11.0
Mount Rushmore NMem	0	n/a	17 to22	17 to 22	7.5
Popo Agie WA	0	n/a	8 to 10	8 to 10	11.9
Soldier Creek WA	0	n/a	13 to 18	13 to 18	9.3

Northern Cheyenne Reservation

Given the proximity of proposed Alternative A emission sources near or on the Northern Cheyenne Indian Reservation, it is understandable that some of the maximum air pollutant impacts would occur on tribal lands. With the exception of a potential non-project and cumulative sources exceedance of the 24-hour PM_{10} Class I Increments, all direct, indirect, and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Indian Reservation: no increased haze days per year from Alternative A project sources directly; up to 38 days per year from non-project sources and up to 42 days per year from all sources cumulatively.

Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities. Dust inhibitors (i.e., surfacing materials, non-saline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local, and resource roads, which present a fugitive dust problem. To further reduce fugitive dust, operators could establish and enforce speed limits (i.e., 15 mph) on all project-required roads in and adjacent to the project area.

Potential emission reduction measures (BLM 1999d) are available to further limit NO_x and other pollutant emissions. The appropriate level of control would be determined and required by the applicable air quality regulatory agencies during the preconstruction permit process. Visibility impacts would be mitigated by reducing emissions of $PM_{2.5}$, NO_2 and SO_2.

- **Reduce Compression Requirements.** Reducing the need for life of project compression by limiting the need for field compressors.
- **Electric Compression.** Using electric-powered compressor motors in place of the typical natural gas-fired compressor engines could eliminate direct NO_x emissions from compressor station locations.
- **BACT.** Best Available Control Technology is expected to be required by the MDEQ for compressor engines. Compressor engines would have an average potential NO_x emission rate of less than the 1.5 grams per horsepower per hour (g/hp-hr) used in the modeling assessment.

Additional discussion of particulate and NO_x emission mitigation measures is provided in the Air Quality Appendix. Some of these measures have been incorporated as management features of the alternatives (see Table 2-1 and Table 2-2 in Chapter 2).

Conclusion

Future development activities must comply with applicable local, state, tribal, and federal air quality laws, statutes, regulations, standards, increments, and implementation plans. Increases in air pollutant emissions would occur under Alternative A. Given the assumptions applied in this analysis, it is unlikely direct air quality impacts from Alternative A project sources would violate any local, state, tribal, or federal air quality standards. When combined with other non-project emission sources, the 24-hour PM_{10} PSD Class II increment and NAAQS was predicted to be exceeded near the Spring Creek Coal Mine. Additionally, the cumulative impact of Alternative A project and non-project sources was predicted to exceed the 24-hour PM_{10} PSD Class I increment at the Northern Cheyenne Indian Reservation. Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area; and 2) visibility impact thresholds in all sensitive federal PSD Class I and Class II areas.

Alternative B—CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

There is the potential for direct air quality impacts to occur under this alternative. Based on air quality modeling of potential near-field (direct, indirect, and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2, and PM_{10} concentrations could occur, and some maximum concentrations are predicted to be above applicable state and National Ambient Air Quality Standards (NAAQS) and PSD increments.

The modeled impacts from project sources are shown in Table 4-8. These results, which are all below the MAAQS, NAAQS and PSD increments, are for near-field modeling. Far-field modeling results for project sources are also below the MAAQS, NAAQS and PSD Increments. (Refer to "Project Sources Only" columns in the following tables.)

Alternative B project sources by themselves would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 3.3 percent, which equates to an 0.19 μeq/l change. This is below threshold level of 1.0 μeq/l.

Even without other development in the region, Alternative B project sources alone may directly degrade visibility within seven mandatory federal PSD Class I Areas. Impacts greater than a "just noticeable change" of 1.0 dv was predicted to average 3 days per year within the Washakie Wilderness Area (maximum 3.7 Δdv), 2 days per year within the Bridger, Fitzpatrick and North Absaroka Wilderness Areas (maximum 2.4, 2.3, and 3.6 Δdv, respectively, and 1 day per year within the Teton Wilderness Area, U.L. Bend Wilderness Area and Yellowstone National Park (maximum 2.1, 4.3 and 3.0 Δdv, respectively). Given their proximity to anticipated Alternative B project sources, average annual visibility changes were also predicted to occur on up to 33 days within the redesignated PSD Class I Northern Cheyenne Indian Reservation (maximum 13.4 Δdv).

For PSD Class II areas, Alternative B project sources were predicted to impact visibility of greater than 1.0 dv on 9 days within the Bighorn Canyon National Recreation Area (maximum 5.4 Δdv), and on up to 61 days within the PSD Class II Crow Indian Reservation (maximum 21.5 Δdv). Less extensive potential direct visibility impacts were also predicted for the PSD Class II Absaroka-Beartooth Wilderness Area (up to 2 days per year, max. 5.0 Δdv), Cloud Peak Wilderness Area (up to 6 days per year, max. 3.8 Δdv), Popo Agie Wilderness Area (up to 2 days per year, max. 2.6 Δdv), Devils Tower National Monument (up to 1 day per year, max. 2.8 Δdv) and Fort Belknap Indian Reservation (up to 1 day per year, max. 4.1 Δdv).

TABLE 4-8
ALTERNATIVE B—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact (μg/m^3)	PSD[1] Increments Class II (μg/m^3)	Montana Background (μg/m^3)	Total[2] Impact (μg/m^3)	Montana AAQS (μg/m^3)	NAAQS (μg/m^3)
NO_2	Annual	9.1	25	11	20.1	100	100
	1-hour	99.7	n/a	117	217	566	n/a
SO_2	Annual	0.66	20	16	17	60	80
	24-hour	2.1	91	73	75	260	365
	3-hour	3.5	512	291	295	n/a	1,300
	1-hour	4.6	n/a	666	671	1,300	n/a
PM_{10}	Annual	3.6	17	30	34	50	50
	24-hour	12.1	30	105	117	150	150
$PM_{2.5}$	Annual	1.4	n/a	8	9	15	15
	24-hour	6.2	n/a	20	26	65	65
CO	8-hour	74.1	n/a	6,600	6,674	10,000	10,000
	1-hour	109	n/a	15,000	15,109	26,000	40,000

[1] PSD Increment is to be compared to the Project Modeled Impact.
[2] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

Temporary Impacts

Based on modeling, the potential maximum 24-hour average PM_{10} concentration due to fugitive dust emissions from the largest construction site of the Montana Project (6-acre sales compressor station with a two-track road 480 m long and 12 m wide) was estimated to be about 57 μg/m^3, occurring about 400 m away from the center of construction site and about 200 m from the road. Although the temporary, short-term impacts of fugitive dust emissions from a construction site are not usually subjected to the requirements of ambient air quality standards, the total PM_{10} concentration, including the contributions from the largest construction site of the Montana Project, was estimated and compared with applicable MTAAQS and NAAQS. Adding the estimated potential maximum 24-hour average PM_{10} concentration increase of 57 μg/m^3 to the background concentration of 105 μg/m^3 would amount to a total concentration of about 162 μg/m^3, which is about 108 percent of MTAAQS. All other construction sites of the Montana Project would be smaller in size than the 6-acre sales compressor station construction site, and therefore, potential PM_{10} concentration impacts at these smaller sites would be less.

In addition, it is anticipated that temporary electrical generators would be used during construction of the compressor stations. The exact number of temporary natural gas and diesel generators for compressor stations cannot be predicted, but typical emission factors were used to estimate the near-field impacts from one temporary diesel generator. The potential ground-level concentrations resulting from operation of a temporary generator are as follows: CO 1-hour up to 403 μg/m^2, CO 8-hour up to 243 μg/m^2; NO_2 24-hour up to 7.5 μg/m^2; NO_2 annual up to 5.3 μg/m^2; $PM_{2.5}$ 3-hour up to 0.4 μg/m^2; $PM_{2.5}$ annual up to 0.4 μg/m^2; SO_2 3-hour up to 0.4 μg/m^2; SO_2 24-hour up to 0.3 μg/m^2; and SO_2 annual up to 0.013 μg/m^2. All concentrations are well below the ambient air quality standards.

The HAP impact analysis was based on a maximum assumed six-unit reciprocating compressor engine station as described in the Air Quality Modeling Appendix. Since neither the MDEQ nor EPA have established HAP standards, predicted 8-hour HAP concentrations were compared to a range of 8-hour state maximum Acceptable Ambient Concentration Levels (EPA 1997a). Formaldehyde was the only HAP predicted to exceed even the lowest threshold level. The maximum predicted cumulative 8-hour formaldehyde impact was 11.9 μg/m^3, which is within the threshold range of 4.5 μg/m^3 (Pinnellas County Air Pollution Control Board, Florida) to 71 μg/m^3 (State of Nevada, Division of Environmental Protection, Air Quality Control). The maximum formaldehyde concentration was predicted to occur at 85 meters (less then 300 feet) adjacent to a compressor station; as the distance from the emission source increases, the predicted concentrations decrease rapidly.

Analysis was conducted to determine the possible incremental cancer-risk over a 70 year lifetime for a most likely exposure (MLE) to residents, and to a maximally exposed individual (MEI), such as compressor station workers. These cancer risks were calculated based on the maximum predicted annual concentrations, EPA's unit risk factors for carcinogenic compounds (EPA 1997b), and an adjustment for time spent at home or on the job. This analysis assumed that residential exposure would be 20 years (well over the national nine year average duration a family lives at a residence) and worker exposure would be 20 years (the full life of project). In addition, it was assumed that family members would be exposed to the maximum formaldehyde concentrations 64 percent of the day, and to one forth of this concentration for the remaining 36 percent of the day.

The resulting incremental cancer risks were calculated to be 1.6×10^{-6} (MLE) and 2.2×10^{-6} (MEI). Both of these values fall near the lower end of the 1 to 100×10^{-6} threshold. The MLE and MEI cancer risks would fall below this threshold at 310 and 460 meters away from the emission source, respectively. This distance would be even less for smaller compressors.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative B. Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 107 μg/m^3 for 24-hr PM_{10}. When combined with the assumed background level of 105 μg/m^3, the total impact of 211 μg/m^3 would exceed the 24-hour PM_{10} NAAQS of 150 μg/m^3. The Alternative B project sources contribute a maximum 12.1 μg/m^3 alone. The project sources combined with the RFFA (Indian Reservation and Forest Service) developments contribute a total of 13.1 μg/m^3 and the non-project sources contributed 104μg/m^3. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore the sum of the individual contributions will not always equal the cumulative totals.)

Furthermore, a maximum near-field cumulative impact for 24-hour $PM_{2.5}$ was determined to be 46 μg/m^3. When combined with the assumed background level of 20 μg/m^3, the total impact of 66 μg/m^3 would exceed the 24-hour $PM_{2.5}$ NAAQS of 65 μg/m^3. Note that the Alternative B project sources contribute a maximum 6.2 μg/m^3 alone. The project sources combined with the RFFA (Indian Reservation and Forest Service) developments contribute a total of 6.9 μg/m^3 (see Table 4-9).

In addition, Alternative B non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Indian Reservation and the Washakie Wilderness area. For the Northern Cheyenne Indian Reservation the far-field analysis indicated a maximum increment level of 12.8 μg/m^3 with the non-project sources contributing 8.4 μg/m^3 and project sources contributing up to 4.2 μg/m^3 alone. The project sources combined with the RFFA

(Indian Reservation and Forest Service) developments contribute a total of 5.9 $\mu g/m^3$.

For the Washakie Wilderness `Area the far-field analysis indicated a maximum increment level of 9.2 $\mu g/m^3$ with the non-project sources contributing 7.2 $\mu g/m^3$ and project sources contributing up to 1.4 $\mu g/m^3$ alone. The project sources combined with the RFFA (Indian Reservation and Forest Service) developments contribute a total of 2.0 $\mu g/m^3$.

Alternative B non-project sources also have the potential to exceed the PSD Class I increment for annual NO_2 on the Northern Cheyenne Indian Reservation (see Table 4-10). The far-field analysis indicated a maximum increment level of 4.2 $\mu g/m^3$ with the non-project sources contributing 0.5 $\mu g/m^3$ and project sources contributing up to 1.9 $\mu g/m^3$ alone. The project sources combined with the RFFA (Indian Reservation and Forest Service) developments contribute a total of 3.7 $\mu g/m^3$.

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 107 $\mu g/m^3$ exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}. The non-project source contribution was predicted to be up to 104$\mu g/m^3$ and the project source contribution was predicted to be up to 12.1 $\mu g/m^3$ alone. The project

TABLE 4-9
ALTERNATIVE B POTENTIAL NAAQS/MAAQS EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Back-ground	Cumulative Total	NAAQS/ MAAQS
Near-Field	$PM_{2.5}$ 24-hr	6.2	6.9	44.1	20	66	65/---
Near-Field	PM_{10} 24-hr	12.1	13.1	104	105	212	150/150

TABLE 4-10
ALTERNATIVE B POTENTIAL PSD INCREMENTS EXCCEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	PSD Class I Increment	PSD Class II Increment
N. Cheyenne IR	PM_{10} 24-hr	4.2	5.9	8.4	12.8	8	
N. Cheyenne IR	NO_2 Annual	1.9	3.7	0.5	4.2	2.5	
Washakie WSA	PM_{10} 24-hr	1.4	2.0	7.2	9.2	8	
Near-Field	PM_{10} 24-hr	12.1	13.1	103.8	107		30

sources combined with the RFFA (Indian Reservation and Forest Service) developments contribute a total of 13.1 μg/m^3.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 μeq/l), the predicted cumulative impact of 1.8 μeq/l change would exceed the threshold level of 1.0 μeq/l. Approximately 11 percent of this change would be attributable to Alternative B project sources alone. Additionally, the potential cumulative impact of 10.4 μeq/l change would exceed the threshold level of 10 μeq/l for Florence Lake in the Class II Cloud Peak Wilderness Area.

Note that potential visibility impacts were predicted to occur from Alternative B non-project sources alone in every sensitive area analyzed. When Alternative B project sources are included in the cumulative analysis, average daily visibility impacts increase by 1 to 3 days per year at most areas, except the Northern Cheyenne Indian Reservation and Class II Crow Reservation. Both are located near the potential Alternative B sources.

Cumulative impacts from non-project, Alternative B and RFFA sources are likely to degrade visibility within fourteen of the fifteen mandatory federal PSD Class I Areas. When Alternative B project sources are combined with the RFFA (Indian Reservation and Forest Service) developments cumulative impacts resulted in an increase of 1 to 5 days per year, as shown in the table below. The cumulative impacts ranged from a total of 2 to 32 days per year for these Class I areas with a maximum Δdv of 29.1 for the U.L. Bend WA.

Modeled project sources could impact seven of the PSD Class I Areas. A "just noticeable change" of 1.0 dv was predicted to average 3 day per year within the Washakie Wilderness Area, 2 days per year within the Bridger, Fitzpatrick and North Absaroka Wilderness Areas, and 1 day per year within the Teton Wilderness Area, U.L. Bend Wilderness Area and Yellowstone National Park (see Table 4-11).

Given their proximity to anticipated Alternative B emission sources, cumulative average annual visibility changes were also predicted to occur on up to 92 days per year within the redesignated PSD Class I Northern Cheyenne Indian Reservation. The maximum Δdv was modeled to be 54.8. Project sources alone contributed up to 33 days per year. The project sources combined with the RFFA (Indian Reservation and Forest Service) developments contribute a total of 60 days per year. Although no direct visibility impacts to the Fort Peck IR may be attributable to Alternative B project sources, the cumulative impact was predicted to increase 3 days per year with a maximum Δdv of 7.4.

For PSD Class II areas, cumulative impacts from project sources combined with the RFFA (Indian Reservation and Forest Service) sources and non-project sources were predicted to be 11 days to 116 days per year, as shown in Table 4-12 below with a maximum Δdv of 66.9 (on Crow IR). The Alternative B project sources combined with RFFA sources contributed generally 1 to 55 days per year to these cumulative totals. Alternative B project source impacts were predicted to occur on 9 days within the Bighorn Canyon National Recreation Area, and on up to 61 days within the PSD Class II Crow Indian Reservation. Less extensive potential direct visibility impacts were also predicted for the PSD Class II Absaroka-Beartooth Wilderness Area (up to 9 days per year), Cloud Peak Wilderness Area (up to 6 days per year), Popo Agie Wilderness Area (up to 2 days per year), Devils Tower National Monument (up to 1 day per year) and Fort Belknap Indian Reservation (up to 1 day per year). Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

Crow Reservation

Given the proximity of proposed Alternative B emission sources near or on the Crow Indian Reservation, it is understandable that air pollutant impacts would occur on tribal lands. All direct, indirect, and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Indian Reservation: up to 61 days per year from Alternative B project sources directly; up to 75 days per year from project and RFFA sources; up to 61 days per year from non-project sources; and up to 116 days per year from all sources cumulatively. The maximum Δdv was 66.9.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative B emission sources near or on the Northern Cheyenne Indian Reservation, it is understandable that some of the maximum air pollutant impacts could occur on tribal lands. With the exception of a potential non-project and cumulative source exceedance of the 24-hour PM_{10} and annual NO_2 Class I Increments, all direct, indirect, and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the

Northern Cheyenne Indian Reservation: up to 33 days per year from Alternative B project sources directly; up to 60 days per year from project and RFFA sources; up to 38 days per year from non-project sources and up to 92 days per year from all sources cumulatively. The maximum Δdv was 54.5.

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative B sources would be the same as those presented for Alternative A sources above.

Conclusion

Future development activities must comply with applicable local, state, tribal, and federal air quality laws, statutes, regulations, standards, increments, and implementation plans. Increases in air pollutant emissions that could occur under Alternative B, resulting in direct air quality impacts would not be permitted. It is unlikely direct air quality impacts from Alternative B project sources alone would violate local, state, tribal or federal air quality standards.

TABLE 4-11
ALTERNATIVE B CLASS I AREA POTENTIAL VISIBILITY IMPACTS

	Contributions Visibility (No. of days >1.0dv/yr)				
Location	**Project Sources Only**	**Project + RFFA Sources**	**Non-Project Sources**	**Cumulative Total**	**Maximum Δdv**
Badlands WA	0	0	17 to 25	21 to28	10.9
Bridger WA	2	3	8 to 10	10 to 12	13.3
Fitzpatrick WA	2	3	7 to 9	10 to 12	16.6
Fort Peck IR	0	1	1 to 2	4 to 5	7.4
Gates of the Mountains WA	0	0	3 to 4	4 to 4	15.0
Grand Teton NP	0	0	4 to 6	6 to 8	7.0
N. Absaroka WA	2	4	10 to 12	13 to 15	14.9
N. Cheyenne IR	33	60	30 to 38	87 to 92	54.8
Red Rock Lakes WA	0	0	0 to 1	2 to 3	2.9
Scapegoat WA	0	0	2 to 2	3 to 3	9.9
Teton WA	1	3	7 to 9	10 to 11	14.6
Theodore Roosevelt NP (N. Unit)	0	0	1 to 2	2 to 3	3.7
Theodore Roosevelt NP (S. Unit)	0	1	2 to 4	4 to 7	4.6
U.L. Bend WA	1	1	5 to 5	6 to 8	29.1
Washakie WA	3	5	11 to 14	16 to 18	24.8
Wind Cave NP	0	0	21 to 27	25 to 32	9.1
Yellowstone NP	1	3	9 to 11	12 to 13	12.8

TABLE 4-12
ALTERNATIVE B CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0dv/yr)				
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	Maximum Δdv
Absaroka Beartooth WA	2	4	28 to 29	32 to 33	21.5
Agate Fossils Bed NM	0	0	10 to 15	14 to 19	12.8
Bighorn Canyon NRA	9	17	19 to 21	32 to 34	34.0
Black Elk WA	0	1	20 to 26	24 to 31	9.4
Cloud Peak WA	6	10	21 to 28	35 to 39	16.3
Crow IR	61	75	56 to 61	113 to 116	66.9
Devils Tower NM	1	3	24 to 38	34 to 47	11.4
Fort Belknap IR	1	1	60 to 61	61 to 62	28.4
Fort Laramie NHS	0	1	13 to 17	16 to 20	16.9
Jewel Cave NM	0	0	24 to 31	28 to 36	12.1
Mount Rushmore NMem	0	0	17 to22	20 to 26	8.4
Popo Agie WA	2	3	8 to 10	11 to 13	14.6
Soldier Creek WA	0	0	13 to 18	16 to 21	11.4

When Alternative B project source impacts are combined with the RFFA (Indian Reservation and Forest Service) sources and non-project sources, the 24-hour PM_{10} NAAQS and the 24-hour $PM_{2.5}$ NAAQS were predicted to be exceeded near the Spring Creek Coal Mine. In addition, cumulative impact of Alternative B project, RFFA and non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} and PSD Class I Increment for annual NO_2 on the Northern Cheyenne Indian Reservation, as well as the PSD Class I increment for 24-hour PM_{10} on the Washakie Wilderness area.

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 107 $\mu g/m^3$ exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}.

Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and in Florence Lake in the Class II Cloud Peak Wilderness Area; and 2) visibility impact thresholds in all PSD Class I and Class II area (including 15 mandatory federal PSD Class I areas) included in this analysis.

Alternative C—Emphasize CBM Development

Potential direct and cumulative air quality impacts are comparable to Alternative B.

Alternative D—Encourage CBM Exploration and Development While Maintaining Existing Land Uses

Potential direct air quality impacts could occur under this alternative. Based on air quality modeling of potential near-field (direct, indirect, and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2, and PM_{10} concentrations could occur, but most maximum concentrations are expected to be below applicable state and NAAQS, as well as NAAQS PSD increments and some maximum concentrations are predicted to be above applicable state and NAAQS and PSD increments.

The modeled impacts from project sources only are shown in Table 4-13 below. These results, which are all below the MAAQS, NAAQS and PSD increments, are for near-field modeling. Far-field modeling results for project sources were also found to be below the MAAQS, NAAQS and PSD Increments. (Refer to "Project Sources Only" columns in the following tables.)

Alternative D project sources by themselves would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 1.8 percent, which equates to an 0.1 μeq/l change. This is below threshold level of 1.0 μeq/l set as the level of significant impact.

Alternative D project sources by themselves are likely to directly degrade visibility within one mandatory federal PSD Class I Area. A greater than "just noticeable change" of 1.0 dv was predicted to average 1 day per year within the Washakie Wilderness Area (maximum 2 Δdv) and up to 17 days within the redesignated PSD Class I Northern Cheyenne Indian Reservation (maximum 8 Δdv).

For PSD Class II areas, Alternative D project sources were predicted to impact visibility greater than 1.0 dv on 3 days within the Bighorn Canyon National Recreation Area (maximum 3 Δdv), 1 day within the Cloud Peak Wilderness Area (maximum 2 Δdv) and up to 42 days within the PSD Class II Crow Indian Reservation (maximum 11 Δdv).

Temporary Impacts

Temporary impacts for Alternative D are expected to be comparable to those described under Alternative B.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative D (see Table 4-14). Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 106 μg/m^3. When combined with the assumed background level of 105 μg/m^3, the total impact of 211 μg/m^3 would exceed the 24-hour PM$_{10}$ NAAQS of 150 μg/m^3. The Alternative D project source emissions would contribute a maximum of 10.8 μg/m^3 alone. The project and RFFA sources combined would contribute a maximum of 11.5 μg/m^3. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore the sum of the individual contributions will not always equal the cumulative totals.)

Furthermore, a maximum near-field cumulative impact for 24-hour PM$_{2.5}$ was determined to be 45.3 μg/m^3. When combined with the assumed background level of 20 μg/m^3, the total impact of 65.3 μg/m^3 would exceed the 24-hour PM$_{2.5}$ NAAQS of 65 μg/m^3. Note that the Alternative D project sources contribute a maximum 4.3 μg/m^3 alone. The project and RFFA sources combined contribute 4.7 μg/m^3.

In addition, Alternative D non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM$_{10}$ on the Northern Cheyenne Indian Reservation (see Table 4-15). The far-field analysis indicated a maximum increment level of 9.8 μg/m^3 with the non-project sources contributing 8.4 μg/m^3 and the project sources contributing up to 3.3 μg/m^{3}alone. The project and RFFA sources combined contribute 4.4 μg/m^3.The far-field analysis also indicated a maximum cumulative increment level of 8.1 μg/m^3 for the Washakie WA. Non-project sources were determined to contribute 7.2 μg/m^3 and the project sources contributing up to 0.61 μg/m^{3}alone. The project and RFFA sources combined contribute 0.85 μg/m^3.

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 106 μg/m^3 exceeds the Class II increment of 30 μg/m^3 for 24-hour PM$_{10}$. The non-project sources contribution was predicted to be up to 104 μg/m^3 and the project sources contributions were predicted to be up to 10.8 μg/m^3 alone. The project and RFFA sources combined contribute 11.5 μg/m^3.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 μeq/l), the predicted cumulative impact of 1.7 μeq/l change would exceed the threshold level of 1.0 μeq/l. Approximately 6 percent of this change would be attributable to Alternative D project sources alone.

TABLE 4-13
ALTERNATIVE D—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact (μg/m^3)	PSD Increments[1] (μg/m^3) Class II	Montana Background (μg/m^3)	Total[2] Impact (μg/m^3)	Montana AAQS (μg/m^3)	NAAQS (μg/m^3)
NO_2	Annual	6.4	25	17.4	20.1	100	100
	1-hour	49.5	n/a	167	217	566	n/a
SO_2	Annual	0.65	20	16.7	17	60	80
	24-hour	2.1	91	75.1	75	260	365
	3-hour	3.5	512	295	295	n/a	1,300
	1-hour	4.5	n/a	671	671	1,300	n/a
PM_{10}	Annual	3.3	17	33.3	34	50	50
	24-hour	10.8	30	116	117	150	150
$PM_{2.5}$	Annual	1.2	n/a	9.2	9	15	15
	24-hour	4.3	n/a	24.3	26	65	65
CO	8-hour	29.1	n/a	6,629	6,674	10,000	10,000
	1-hour	47.6	n/a	15,048	15,109	26,000	40,000

[1] PSD Increment is to be compared to the Project Modeled Impact .
[2] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

TABLE 4-14
ALTERNATIVE D POTENTIAL NAAQS/MAAQS EXCEEDANCES

		Contributions (μg/m^3)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Back-ground	Cumulative Total	NAAQS/ MAAQS
Near-Field	$PM_{2.5}$ 24-hr	4.3	4.7	44.1	20	65	65/---
Near-Field	PM_{10} 24-hr	10.8	11.5	103.8	105	211	150/150

TABLE 4-15
ALTERNATIVE D POTENTIAL PSD INCREMENTS EXCEEDANCES

Location	Pollutant	Contributions (μg/m³) Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	PSD Class I Increment	PSD Class II Increment
N. Cheyenne IR	PM_{10} 24-hr	3.3	4.4	8.4	11.1	8	
Washakie WSA	PM_{10} 24-hr	0.61	0.85	7.2	8.1	8	
Near-Field	PM_{10} 24-hr	10.8	11.5	103.8	106.5		30

Note that potential visibility impacts were predicted to occur from Alternative D non-project sources alone in every sensitive area analyzed. When Alternative D project and RFFA sources are included in the cumulative analysis, the average daily visibility impacts increase by 1 to 2 days per year for thirteen of the fifteen areas as noted (see Table 4-16). The maximum Δdv was predicted to be 26.0 at the U.L. Bend WA.

Alternative D project sources alone are likely to directly degrade visibility within only one of the fifteen mandatory federal PSD Class I Areas. A change of 1.6 dv was predicted to average 1 day per year within the Washakie Wilderness Area.

For PSD Class II areas, Alternative D project source impacts were predicted to occur on up to 1 day within the Cloud Peak Wilderness Area (maximum 1.9 Δdv) and up to 3 days within the Bighorn Canyon National Recreation Area (maximum 2.6 Δdv). Cumulative impacts from project with RFFA sources and non-project sources were predicted to be up to 35 days and 28 days per year, respectively.

The Alternative D project sources with RFFA sources contributed generally 1 to 7 days per year to the cumulative totals for the Class II areas listed in Table 4-17. The maximum Δdv was predicted to be 30.6 at the Bighorn Canyon NRA and 59.3 at the Crow Indian Reservation. Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

Crow Reservation

Given the proximity of proposed Alternative D emission sources near or on the Crow Indian Reservation, it is understandable that air pollutant impacts would occur on tribal lands. All direct, indirect, and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Indian Reservation: up to 42 days per year from Alternative D project sources directly; up to 56 days per year from project and RFFA sources combined; up to 61 days per year from non-project sources; and up to 105 days per year from all sources cumulatively. The maximum Δdv was predicted to be 59.3.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative D emission sources near or on the Northern Cheyenne Indian Reservation, it is understandable that air pollutant impacts would occur on tribal lands. With the exception of a potential non-project and cumulative source exceedance of the 24-hour PM_{10} Class I Increments, all direct, indirect, and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Indian Reservation: up to 17 days per year from Alternative D project sources directly; up to 38 days per year from project and RFFA sources combined;

TABLE 4-16
ALTERNATIVE D CLASS I AREA POTENTIAL VISIBILITY IMPACTS

	Contributions Visibility (No. of days >1.0dv/yr)				
Location	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	Maximum Δdv
Badlands WA	0	0	17 to 25	20 to26	10.4
Bridger WA	0	1	8 to 10	9 to 11	11.7
Fitzpatrick WA	0	0	7 to 9	8 to 10	14.6
Fort Peck IR	0	0	1 to 2	2 to 3	6.5
Gates of the Mountains WA	0	0	3 to 4	3 to 4	13.7
Grand Teton NP	0	0	4 to 6	5 to 7	6.3
N. Absaroka WA	0	1	10 to 12	12 to 14	12.4
N. Cheyenne IR	17	38	30 to 38	70 to 76	47.9
Red Rock Lakes WA	0	0	0 to 1	1 to 2	2.6
Scapegoat WA	0	0	2 to 2	2 to 3	8.9
Teton WA	0	0	7 to 9	9 to 10	12.9
Theodore Roosevelt NP (N. Unit)	0	0	1 to 2	1 to 2	3.5
Theodore Roosevelt NP (S. Unit)	0	0	2 to 4	3 to 5	4.2
U.L. Bend WA	0	0	5 to 5	5 to 6	26
Washakie WA	1	1	11 to 14	14 to 16	21.9
Wind Cave NP	0	0	21 to 27	23 to 29	8.2
Yellowstone NP	0	0	9 to 11	11 to 12	10.5

TABLE 4-17
ALTERNATIVE D CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0dv/yr)				
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	Maximum Δdv
Absaroka Beartooth WA	0	1	28 to 29	30 to 31	17.8
Agate Fossils Bed NM	0	0	10 to 15	12 to 17	11.4
Bighorn Canyon NRA	3	7	19 to 21	25 to 28	30.6
Black Elk WA	0	0	20 to 26	22 to 28	8.8
Cloud Peak WA	1	2	21 to 28	28 to 35	14.9
Crow IR	42	56	56 to 61	102 to 105	59.3
Devils Tower NM	0	0	24 to 38	29 to 42	10.3
Fort Belknap IR	0	0	60 to 61	61 to 61	25.5
Fort Laramie NHS	0	0	13 to 17	15 to 18	15.5
Jewel Cave NM	0	0	24 to 31	26 to 34	11.5
Mount Rushmore Nmem	0	0	17 to22	18 to 23	7.9
Popo Agie WA	0	1	8 to 10	9 to 11	12.9
Soldier Creek WA	0	0	13 to 18	14 to 20	10.1

up to 38 days per year from non-project sources; and, up to 76 days per year from all sources cumulatively. The maximum Δdv was predicted to be 47.9.

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative D sources would be the same as those presented for Alternative A sources above.

Conclusion

Future development activities must comply with applicable local, state, tribal, and federal air quality laws, statutes, regulations, standards, increments, and implementation plans. Increases in air pollutant emissions would occur under Alternative D. Given the assumptions applied in this analysis, it is unlikely direct air quality impacts from Alternative D project sources alone would violate any local, state, tribal, or federal air quality standards.

When combined with Alternative D non-project sources and RFFA sources, the 24-hour PM_{10} NAAQS and 24-hour $PM_{2.5}$ NAAQS was predicted to be exceeded near the Spring Creek Coal Mine. In addition, the cumulative impact from Alternative D project sources with RFFA sources and non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Indian Reservation. For Class II areas near the Spring Creek Coal Mine, the cumulative impact is predicted to exceed the Class II increment for 24-hour PM_{10}.

Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area; and 2) visibility impact thresholds in all PSD Class I and Class II areas (including 15 mandatory federal PSD Class I areas) included in this analysis.

Alternative E—Preferred CBM Development Alternative

Potential direct and cumulative air quality impacts are comparable to Alternative B. Although the air quality modeling shows the potential for certain standards to be exceeded, these impacts would not occur. The air quality permitting process would be used to analyze emission sources at the project level for CBM development and develop any mitigation needed. Emission sources that would violate standards would not be permitted by the agencies and therefore, residual impacts would remain within standards.

Cultural Resources

Cultural Resources *Approximately 73,600 cultural resource sites exist above known coal resources within the CBM emphasis area*
Alternative A **No Action (Existing CBM Management)**
• An estimated 17 cultural resource sites could be identified during foreseen CBM activities. Of these only one or two would likely be eligible for the NRHP. • Cumulative Impacts: – An estimated 4,285 cultural sites could be identified resulting in 430 to 612 sites that could be eligible for the NRHP.
Alternatives B, C, D, and E
• The number of cultural resource sites identified would be practically the same for Alternatives B, C, D, and E based on the level of development, associated area of disturbance and minor differences between the alternative realty management actions. An estimated 630 cultural resource sites could be identified, of these sites, 120 to 170 could be eligible for the NRHP. • Cumulative Impacts: – An estimated 5,135 cultural sites could be identified resulting in 515 to 735 sites that could be eligible for the NRHP. – Potential for impacts to TCPs would increase with the development of CBM.

Assumptions

Cultural resources would be treated similarly and equally in terms of type, composition, and significance; their distributions and densities are detailed in Chapter 3. Cultural resources are treated in this manner only for purposes of evaluation in this report, since the particular cultural resources to be affected are not necessarily known at this time. It must be understood that not all cultural resources are equal in terms of importance, National Register eligibility, density, and location. Federally recognized tribes will need to be consulted as to their needs for cultural resources even off reservation. Most of the mitigation for Native American cultural resources will entail avoidance, particularly any site associated with burials of human remains. Cultural resource attributes will have to be taken into consideration when impacts are considered for each individual CBM development. Operators will need to develop an approach for mitigating cultural resources based on the plan for CBM development that they submit. The Cultural Resource section of that plan will need to include the following guidelines in BLM's 8100 Manual Series, the Secretary of the Interior's Standards and Guidelines For Archaeology and Historic Preservation (FR 48 (190)44716-44742, 1983), and the Advisory Council on Historic Preservation's document the "Treatment of Archaeological Properties" (ACHP 1980)

Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. There would be one site for every 100 acres surveyed for cultural resources. This assumption was made by averaging the number of sites vs. acres surveyed in the planning area from existing surveys. This estimate is based on surveys that covered 19 percent of the estimated CBM development area. The actual number of cultural resources in a particular CBM development field could vary dramatically depending on the exact location of the field.

Impacts From Management Common To All Alternatives

Cultural resources would be impacted by surface and subsurface disturbing activities. Activities that involve the use of heavy equipment (road construction, well drilling, pad construction, pipeline and utility placement, etc.) that result in changes to the natural landscape could cause the most disturbance and could have the greatest effect on cultural resources. Other activities, such as increased travel and vandalism resulting from access improvements, and increased erosion resulting from surface disturbances, would also impact cultural resources. These activities can also produce indirect impacts to cultural resources from fires; and to rock art sites from gas emissions, abrasive dust, and vibrations from drilling equipment. Noise, activity, traffic and smells can affect the quality and continued use of Traditional Cultural Properties (TCPs). Traditional Cultural Properties important to the Northern Cheyenne and Crow and their perceptions of mitigation are presented in The Northern Cheyenne Tribe and its Reservation: 2002 (The Northern Cheyenne Tribe 2002), Crow Indian Reservation (Crow Tribe of Indians 2002) and An Ethnographic Overview of Southeast Montana (Peterson and Deaver 2002).

Impacts would occur at an estimated 318 cultural resource sites. Of these sites, 32 to 46 are projected to be eligible for the National Register of Historic Places. The estimated number of sites includes 176 cultural resource sites from disturbance by conventional oil and gas development, and 142 sites as a result of impacts caused by cumulative projects foreseen including surface coal mining activities. Additional cultural site could be found as a result of cultural resource inventories conducted before beginning surface disturbing activities. Locating cultural resource sites would result in the accumulation of additional artifacts and information.

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Alternative A has the least impact to cultural resources of all alternatives since this alternative has the least amount of surface and subsurface disturbance. Approximately 17 cultural resource sites would be identified by all projected CBM activities in state and BLM planning areas. An estimated four sites would be impacted from exploration activities in state planning areas; six sites would be impacted from production activities at CX Ranch; and seven would be impacted from exploration activities in BLM planning areas. One or two of these identified sites could be found eligible for the National Register of Historic Places. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from production.

Crow Reservation

Impacts to the Crow Reservation are not expected because no exploration wells are planned for installation on the Reservation at this time. However if exploration wells were to be drilled on the Reservation the likelihood of site impacts would occur at a similar frequency as described for Cultural Resources in general though there could be an increase in cultural resource sites identified because of the increased number of possible TCPs.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation also are not expected at this time because the Northern Cheyenne have not indicated that exploration wells would be drilled. As with the Crow Reservation, it is anticipated that when and if the Northern Cheyenne explore their Reservation for CBM resources cultural sites would be encountered on the same regularity as described for Cultural Resources in general. It is conceivable that the density of cultural sites would be increased on the Reservation because of the increased possibility of TCPs. It is assumed that the Tribe would be involved in all surveys and site inspections on the reservation. Therefore, the incidents of cultural resource impacts could be minimized, and possibly avoided altogether.

Conclusion

Over the next 20 years, disturbances from CBM development, conventional oil and gas development, and other cumulative effect analysis project activities could identify 4,285 cultural resource sites of which 430 to 612 could be eligible for the National Register. Impacts from surface disturbance would be minimized by using existing disturbances where possible, and by allowing aboveground utility lines. The impacts from erosion as a result of surface discharge of produced water at CX Ranch would be negligible because of the conveyance systems used to transport the relatively small amount of discharged water. The mitigation measures would be the same as those discussed in Chapter 2. However, given the number of acres likely to be disturbed by all anticipated CBM development, it is unlikely that it would be necessary to mitigate sites or cultural properties through data recovery. In almost all situations, direct impacts to cultural properties would be avoided by relocating well sites or pipelines. Monitoring may indicate sites adjacent to the development fields are being indirectly affected by vandalism and other types of indirect impacts in which case data recovery would be the preferred mitigation. Consultation with tribes may indicate the presence of TCPs that would have to be avoided or which would require alteration of the well field plan in order to mitigate impacts to TCPs.

These are the best estimates of cultural resources that can be derived at this level of study. It is understood that sites occur in clusters based on a host of various criteria (location to water, slope, view, predominate wind, etc) and that some sites are more important than others. A cultural resource location and significance model would be an important and useful tool to help identify areas of critical concern.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Under this alternative, an estimated 629 cultural resource sites would be identified by all projected CBM activities in state and BLM planning areas. Of these sites, 119 to 170 could be found eligible for the National Register of Historic Places. An estimated 16 sites would be impacted by exploration activities in state planning areas, 335 sites from production activities in state planning areas, 10 sites from exploration activities in BLM planning areas, and 269 sites from production activities on BLM planning areas.

Crow Reservation

Impacts on the Crow Reservation would be minimal because no development is anticipated on the reservation at this time. Disturbance totals include TCPs that would be identified off reservation and impacted from the above mentioned activities.

Northern Cheyenne Reservation

There would be no impacts to the Northern Cheyenne Reservation based on commercial CBM development within the region. Disturbance totals include TCPs that would be identified off reservation and impacted from the above mentioned activities.

Conclusion

Over the next 20 years, disturbances from CBM development in state, BLM, Native American, and USFS planning areas; conventional oil and gas development; and surface coal mining activities would identify approximately 5,135 cultural resource sites. Of those sites 515 to 735 would be eligible for the National Register. These totals include traditional cultural properties that would be identified and impacted from the abovementioned activities. The requirement of transportation corridors, one-way in-and-out roads, and the prevention of surface discharge of produced water would help to minimize the number of cultural resource sites impacted. The mitigation measures would be the same as those discussed in Chapter 2.

Alternative C—Emphasize CBM Development

Under this alternative, impacts to cultural resources would be similar to Alternative B with the following exceptions: transportation corridors are not required, thereby increasing the number of disturbed acres and the likelihood of identifying more sites; discharge of produced water directly to the ground surface would increase erosion and site disturbance; power lines may be aboveground or buried, which would decrease the number of disturbed acres. The estimated number of cultural site identified under Alternative C would total 629, with 119 to 170 of these sites being found eligible for the National Register of Historic Places.

Crow Reservation

There would be no impacts to the Crow Reservation from commercial CBM development in the region.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be minimal based on the off-reservation development and avoidance practices employed.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance from roads and utilities would be greater because one-way in-and-out roads and transportation corridors would not be required. Cultural resource inventories would need to be conducted along the surface watercourses. Surface discharge of produced water would result in increased erosion. The discharge of produced water to the surface would increase erosion and cause increased surface disturbance. The increased surface disturbance would be in the area near the production area, and in the downstream segments of perennial streams and valleys leading to the major surface waters. Further discussion of erosion and the disturbances to soils can be found in the Soils section of this chapter. Mitigation measures would be similar to Alternative B with some exceptions. Mitigation measures would include the use of piping instead of discharging waters into drainage ditches in order to minimize erosion.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Under this alternative, impacts to cultural resources would be similar to Alternative B.

Crow Reservation

There would be no impacts on the Crow Reservation or to Crow cultural resources from commercial CBM development within the region.

Northern Cheyenne Reservation

There would be no impacts to Northern Cheyenne cultural resources on the Reservation from off-reservation CBM development. Off-reservation TCPs may be impacted in some locals but avoidance and early identification should eliminate any important sites from being disturbed.

Conclusion

Cumulative impacts would be similar to Alternative B. Mitigation measures would be the same as for Alternative B.

Alternative E—Preferred Alternative

Under this alternative, the impact to cultural resources would be similar to Alternative B with the following exceptions: the removal of an inactive buffer zone around active coal mines and reservations would increase the potential acreage for CBM development and hence potentially increase the number of cultural resources encountered; there might be a decrease in the number of well pads built since operators would be able to use vertical wells for deep coal seams; transportation and utility corridors are not required, thereby increasing the number of disturbed acres and hence encountered sites; power lines may be aboveground or buried, which should decrease the number of disturbed acres in most areas.

The operator's project plan would help develop a survey identification strategy and increase the likelihood of site identification and implementation of mitigation measures. The estimated number of cultural sites identified under Alternative E would total 629, with 119 to 170 of these sites being found eligible for the National Register of Historic Places. Additional cultural site could be found as a result of cultural resource inventories conducted before beginning surface disturbing activities. Locating cultural resource sites would result in the accumulation of additional artifacts and information.

Crow Reservation

No cultural resources would be impacted on the Crow Reservation from commercial CBM development off-reservation lands. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting Native American sites. These measures will reduce the potential impacts to these off-reservation sites and will help in the avoidance and collection of important artifacts.

Northern Cheyenne Reservation

No cultural resources would be impacted on the Northern Cheyenne Reservation from commercial CBM development off-reservation lands. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting the Northern Cheyenne's culturally important sites. These measures include provisions for information sharing, and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites, and human remains.

With these specific measures in place to mitigate impacts to Northern Cheyenne culturally important sites and with the BLM committed to providing technical assistance to the Tribe in inventorying, recording, and evaluating cultural sites, it is plausible that impacts will be reduced.

Conclusion

Cumulative impacts would be similar to those describe under Alternative B; however, with the implementation of specific Northern Cheyenne and general Native American mitigation measures impacts to off-reservation TCP sites will be reduced and data collection efforts enhanced.

Geology and Minerals

Geology and Minerals
Montana's mineral resources are intimately tied to the complex geologic framework of the state. Locatable minerals and conventional Oil and Gas resources are found throughout the planning area in various recoverable and non-recoverable amounts

Alternative A
No Action (Existing CBM Management)

- Federal:
  - Only minor loss of CBM during testing operations.
- State:
  - Irretrievable commitment of CBM resources from production on state planning areas.
  - Delayed development or expansion of conventional oil and gas, coal mining, and surface mineral mining in minor instances with no interruption to existing activities.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  - Irretrievable commitment of CBM resources from production, magnitude and complexity to reflect increase scale of development.
  - Potential mineral drainage between federal mineral estates and state, fee and tribal developments depending on site-specific conditions.
- State:
  - Increased commitment of CBM resources due to increased level of CBM development.
  - Mineral drainage issues same as for federal.
  - The presence of shallow CBM production could delay certain types of seismic prospecting for conventional oil and gas reservoirs

Alternative C
Emphasize CBM Development

- Federal:
  - Same as Alternative B with minor increase in water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.
- State:
  - Same as Alternative B.
  - Potential mineral drainage between federal mineral estates and state, fee, or Tribal developments depending on site-specific conditions.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Federal:
  - Same as Alternative B.
- State:
  - Same as Alternative B.
  - Potential mineral drainage between Federal mineral estates and state, fee, or Tribal developments depending on site-specific conditions.

Alternative E
Preferred CBM Development Alternative

- Federal:
  - Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.
  - Protection of Tribal CBM from drainage because of resource protection protocols.
- State:
  - Potential mineral drainage between federal mineral estates and state, fee or Tribal developments depending on site-specific conditions.

Assumptions

- Federal oil and gas leases would continue to be issued with standard lease terms and stipulations as identified by BLM. No Surface Occupancy (NSO), Controlled Surface Use (CSU) and Timing Restriction (Timing) stipulations provide protection to other resources from oil and gas lease activities. A detailed listing and description of stipulations are found in the Final Oil and Gas EIS/Amendment (BLM 1992).

- Federal APDs and Sundry Notices would continue to be issued with Conditions of Approval (COAs) as identified by BLM. COAs provide mitigation to minimize or eliminate impacts to other resources or land uses from oil and gas activities. COAs must conform to lease rights and land use decisions.

- BLM would continue to consult with private surface owners before approving oil and gas activities on private surface. Surface owner requirements can be incorporated as COAs.

- BLM would continue to require a copy of a signed agreement between the private surface owner and the CBM operator before approving drilling operations on private surface.

- The Miles City Field Office and the Reservoir Management Group located in the Casper BLM Office would share drainage case information for cases within one mile of the Montana Wyoming state line.

- Other related Assumptions regarding typical CBM operations are found at the beginning of this chapter.

Impacts From Management Common to All Alternatives

The production or drainage of oil and gas results in the irreversible and irretrievable loss of these resources. Oil and gas resources within a lease area can be directly removed by wells located on the lease area or drained by wells located adjacent to the lease when geologic conditions allow. Gas resources are irreversibly and irretrievably lost during venting or flaring operations. The cumulative impact to oil and gas resources would be a reduction in the known amount of these resources.

Existing BLM and State regulations allow for the production of oil and gas in a manner that conserves those resources so they are not wasted. Oil and gas production is guided by well spacing rules, field rules, lease development requirements, and protective agreements such as communitization and unitization agreements. Flaring and venting operations must be conducted in accordance with agency approval, which also seeks to limit the wasting of gas resources as well as minimizing air quality and safety impacts.

CBM development in Wyoming would result in drainage to Montana lands by wells just across the state boundary. The 80-mile-wide belt of the Powder River Basin that is prospective for CBM would represent approximately 320 1/4-by-1/2-mile (80-acre) spacing units draining resources (gas) from the adjacent state. Hydrocarbon (including CBM) drainage is mitigated by regulations contained in 43 CFR Parts 3100, 3106, 3108, 3130, and 3160. These regulations are meant to avoid waste and protect correlative mineral rights. Regulatory mechanisms include communitization agreements, protection well demands, and compensatory royalties.

Oil and gas development would impact strippable coal resources in areas adjacent to existing coal mines or in new areas of coal mine interest. Oil and gas well bores and the production infrastructure would prevent the mining of coal in areas of oil and gas production.

BLM-issued oil and gas leases are issued with an NSO stipulation in an area with an active federal coal lease and an approved mine plan. The NSO stipulation prohibits surface occupancy and use for oil and gas lease operations. In areas outside of approved mine plans, BLM may issue both coal and oil and gas leases on the same parcel of land. BLM regulations support approval of applications from the first lessee, but also require lessees to resolve conflicts. Resolution of conflicts is further guided by BLM Instruction Memorandum WO-IM-2000-081 (BLM 2002c).

Conventional oil and gas lease operations would not impact CBM resources because of the geology and well bore requirements. Migration of conventional oil and gas from source reservoirs to coal seams usually does not occur because the geology includes an impermeable layer(s) between the hydrocarbon bearing formations and the coal seams. The BLM and State require well bores to be completed with steel casing and cement in key locations of the well annulus to prevent the migration of fluids and drastically reduce the migration of hydrocarbons from one formation to another formation.

Conventional oil and gas wells and the associated infrastructure could be located on a lease area with CBM wells and associated infrastructure.

Sand, gravel, or scoria needed for lease operations can be removed from BLM land by the operator from areas disturbed by lease operations under authority of the lease. Removal of sand, gravel, or scoria from BLM surface by the operator outside of the area of disturbance for lease operations or removal by a third party would require a separate permit approved by BLM.

Impacts From Management Specific To Each Alternative

Alternative A—No Action (Existing CBM Management)

Under this alternative, CBM production would be limited by the number of wells that can be permitted for CBM production by BLM and the State. The total number of producing CBM wells is limited to 250 by the terms of the Settlement Agreement affecting the State. The constraint is in place until the State has completed an EIS addressing the impacts from CBM field development throughout the state. BLM is not approving the production of CBM from federal wells until completion of the EIS, which addresses the impacts from CBM field development in the Powder River and Billings RMP areas.

The production and venting of CBM during the testing phase represent an irretrievable loss of that resource. Under the existing situation, CBM may be drained from federal lands by producing CBM wells on private and state leases. This drainage of federal CBM represents an irretrievable loss of that resource. The venting of CBM during coal mining represents the irretrievable loss of the resource.

Expansion of the Decker coal mine to the west and south, and expansion of the Spring Creek coal mine to the south would be constrained by CBM wells and the associated infrastructure of the CX Field. Mine expansion could occur after abandonment of the CX Field and removal of facilities and equipment.

Removal of groundwater by CBM wells in coal seams that are being mined by Decker and Spring Creek could reduce the amount of groundwater flowing into the mine areas. Reduction in the amount of groundwater or degradation of groundwater quality by CBM production would reduce the amount of groundwater available for domestic water wells from a particular coal seam. CBM could migrate to domestic wells or escape at the surface from the removal of groundwater for CBM production.

The presence of CBM wells and the associated infrastructure could prevent certain types of seismic operations from being conducted in the area of CBM production. The use of explosives could damage well bores or surface equipment, and could damage the upper coal seam used for CBM production.

Crow Reservation

Producing CBM wells located within 1 mile of the Crow Reservation boundary could drain CBM resources from the Reservation. This drainage of Indian owned or privately owned CBM would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBM wells and associated infrastructure on private and state lands could influence the location of future CBM wells and associated infrastructure on lands within the Crow Reservation. This scenario is not anticipated under Alternative A because of the State Settlement Agreement.

A detailed description of potential drainage impacts to Crow resources is found in the *Environmental Justice* section, and a detailed description of potential impacts to groundwater from drawdown by CBM wells is found in the Hydrology section.

Northern Cheyenne Reservation

It is not anticipated that any producing CBM wells would be located within 1 mile of the Northern Cheyenne Reservation boundary and therefore drainage of Tribal CBM resources from the Reservation is not anticipated.

Conclusion

The production of CBM by state and private wells and the venting of CBM represent the irreversible and irretrievable loss of the resource. The restrictions on the total number of CBM wells approved for production reduces and delays associated revenues to lessees and government. The venting of CBM during coal mining represents the irreversible and irretrievable loss of the resource.

Production of CBM should not impact the geology of the production area or any conventional oil and gas in the area of CBM production. CBM wells and the associated infrastructure would hinder the expansion of the Decker and Spring Creek coal mines toward the CX Field. The production of CBM would not prohibit the production of conventional oil and gas resources from the area of CBM production. The production of conventional oil and gas in or around the CX Field would increase and intensify the impacts to other resources and on land uses.

The mitigation measures for this alternative would be similar to those described in Chapter 2.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Under this alternative, the types of impacts experienced would be similar to those described under Alternative A, but increased because of expanded CBM production on state, fee, and BLM oil and gas lease areas. The increased development as part of this alternative would result in more CBM production and the irretrievable commitment of more resources. Increased CBM production would amplify the opportunity for methane drainage from adjacent leases. Under this alternative, multiple coal seams would be developed from a single well bore. All coal seams would be developed at the same time and directional drilling for deeper coal seams would be required.

This alternative also includes a 1-mile buffer zone around active coal mines that would minimize the operational interference and water drawdown impacts from nearby CBM production. Production of CBM would not be authorized on federal leases within a 2-mile buffer zone in Montana along the Reservation boundary. The state may allow production of CBM from state leases within the buffer zone. The prohibition on the production of CBM within the buffer zone would not apply to fee leases within the buffer zone.

The drawdown of groundwater from coal seams would not damage the coal resource present through compaction, nor would the likelihood of coal seam fires be greater than before. The circumstances for self-ignition of coal would not be present in the direct vicinity of CBM wells in the emphasis area. During the production stage of CBM activity, conditions essential to cultivate spontaneous combustion of coal such as oxidation, heat of wetting, airflow rate, coal particle size, pyrite content and temperature are not present. In fact, the design and construction of CBM wells efficiently vents heat out of the coal so that temperatures needed for coal ignition are neither present nor anticipated.

After the coal seam is exhausted of methane resources, wells must be plugged and sealed. Unlike abandoned mines, CBM wells leave no underground voids vulnerable to further subsidence and associated spontaneous coal ignition. The probability of completely dewatering a coal bed and revealing large areas of fine coal particles to oxygen seem exceedingly remote (Lyman and Volkmer 2001). Further discussion regarding groundwater issues is contained in the *Hydrology* section of this chapter.

The presence of CBM wells and the associated infrastructure could prevent certain types of seismic operations from being conducted in the area of CBM production. The use of explosives could damage well bores or surface equipment and could damage the upper coal seam used for CBM production.

The drawdown of groundwater from CBM activities has been identified as the cause of surface subsidence in Wyoming (Case et al. 2000). The subsidence was recorded as 1/2 inch and therefore, does not represent an immediate impact to surface lands. In Montana where coal seams are thinner, subsidence would be less than what has been observed in Wyoming where coal seams are thicker.

Crow Reservation

Impacts to mineral resources on the Crow Reservation would be the same as described above in this alternative. Producing CBM wells located within 1 mile of the Crow Reservation boundary could drain CBM resources from the Reservation. This drainage of Indian owned or privately owned CBM would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBM wells and associated infrastructure on private and state lands could influence the location of future CBM wells and associated infrastructure on lands within the Crow Reservation. Expanded CBM development activities would increase the impacts and extraction of Tribal CBM resources.

Northern Cheyenne Reservation

Impacts to mineral resources on the Northern Cheyenne reservation would be the same as described above in this alternative. Producing CBM wells located within 1 mile of the Northern Cheyenne Reservation boundary could drain CBM resources from the Reservation. This drainage of Indian owned or privately owned CBM would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBM wells and associated infrastructure on private and state lands could influence the location of future CBM wells and associated infrastructure on lands within the Crow Reservation. Expanded CBM development activities would increase the impacts and extraction of Tribal CBM resources.

Conclusion

One of the cumulative impacts from this alternative would be increased production of CBM from an increased number of producing wells including Tribal wells and from multiple coal seam development simultaneously. Multiple coal seam development simultaneously would result in the production of CBM occurring more quickly than single seam development. Along with venting of CBM during well testing, this would represent an irreversible and irretrievable loss of the resource.

The increased number of producing CBM wells and the associated infrastructure could inhibit the expansion of existing coal mines, even with the 1-mile buffer zone. This would delay or possibly preclude the mining of coal in certain areas. Areas of new coal mine interest would be excluded from opening new coal mines by the existence of producing CBM wells and infrastructure.

The mitigation measures for this alternative would be similar to those described in Chapter 2. Additional mitigation measures include buffer zones around existing coal mines and simultaneous production of multiple coal seams through single well bores, subsurface injection of untreated water produced with CBM, and maximizing the number of producing CBM wells connected to field compressors.

Alternative C—Emphasize CBM Development

Under this alternative, CBM production could occur on state, fee, and BLM lease areas. Operators would not be required to produce CBM simultaneously from multiple coal seams through a single well bore. CBM production from multiple coal seams could occur simultaneously through single well bores or simultaneously through separate well bores or different coal seams could be developed separately (staggered over time) or a combination of production methods.

Allowing CBM production from state, fee, and BLM leases would increase the amount of CBM produced. Producing CBM from multiple coal seams simultaneously would have impacts similar to those described in Alternative B. Producing CBM from single coal seams would have similar impacts, but would extend the length of time for production. The potential for drainage of CBM resources by producing CBM wells would increase with the increase in the number of producing wells. Directional drilling would not be required. Without directionally drilled wells, the impacts from vertical wells would be the same as Alternative A but increased for the scale of development.

CBM production will impact adjacent coal mines by increasing coal bed aquifer drawdown and by interfering with expansion of existing coal mines. The added dewatering from CBM operations would affect the coal mines by hindering and complicating aquifer restoration efforts the mine must perform once mining activities cease. In addition, the removal of coal seam water may create a situation where some coal mines would need to purchase water for dust control.

The drawdown of groundwater does not represent an immediate impact to surface lands resulting from subsidence. The thinness of the coal seam aquifers and their shallow depth should prevent them from being substantially impacted by groundwater withdrawal and subsequent aquifer compaction.

Crow Reservation

Impacts on the Crow Reservation would be the same as described for the study area in general for Alternative C. However, without the 2-mile Reservation buffer zone, Tribal CBM resources would have an increased vulnerability to drainage from adjacent state, federal, and private wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the study area under this Alternative. Furthermore, without the 2-mile Reservation buffer zone, Tribal CBM resources would have an increased vulnerability to drainage from adjacent state, federal, and private wells.

Conclusion

The cumulative impacts for this alternative would be similar to Alternative B with some exceptions. The removal of the requirement for a buffer zone around coal mines would result in increased drawdown and greater operational interference within the mines from CBM production. After mining has ceased, the added dewatering will need to be remediated by the mine operators. Remediation bonds executed by the mine operators prior to operations will need to be honored. Unless the impact of the CBM production can be separated from impacts by the coal mine, the remediation bond will force the mine operator to spend more money to remediate the aquifer. Coal mine operators may develop aquifer mitigation agreements with CBM operators prior to CBM production. The mitigation measures for this alternative would be similar to Alternative A.

Tribal development of CBM resources on reservations would increase the irreversible and irretrievable loss of the resource.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts from management objectives outlined in Alternative D would be similar to the impacts described under Alternative B.

Crow Reservation

Impacts to the Crow Reservation would be similar to impacts described in Alternative B.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to impacts described in Alternative B.

Alternative E—Preferred Alternative

Impacts to coal and existing coal mines would be the same as Alternative C because a buffer zone would not be required around existing coal mines.

Impacts to CBM resources would be the same as Alternative B if all coal seams are produced simultaneously or to Alternative C if coal seams are produced separately. Impacts to CBM production and wells would be the same as Alternative A because multiple seam production through a single well bore would not be required.

Impacts on conventional oil and gas resources would be the same as discussed in the *Management Common* section.

The production of CBM and the venting of CBM represent the irreversible and irretrievable loss of the resource. Drainage by off-lease CBM wells represents the irreversible and irretrievable loss of the resource and royalties to the lessee of the lease being drained.

For Alternative E, the Crow and Northern Cheyenne Reservation would be protected from drawdown of coal seam aquifers and drainage of tribal CBM resources as described in Chapter 2 of this document. To gauge incipient impacts related to groundwater and CBM resource drainage on the Crow and Northern Cheyenne reservations, monitoring wells would be required to be installed during the exploration phase on all BLM-administered oil and gas leases that show hydrologic connectivity with the reservation aquifers.

Crow Reservation

Impacts to the Crow Reservation from federal lease operators under Alternative E would be minimized. A buffer zone would not be established around the borders of the Reservation. However, other mitigation options would be available for consideration by the Tribes. These include reducing production rates, shutting in the well or wells, payment of compensatory royalties, establishment of communitization agreements, or spacing to protect reservation CBM resources from drainage. Under this alternative, there would be no drainage of tribal CBM resources by federal lease operators. The potential for drainage by fee lands within the reservation boundary and along the exterior boundary would still exist.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation from federal lease operators under Alternative E would be minimized. A buffer zone would not be established around the borders of the Reservation. The BLM has the responsibility to use reasonable means to prevent drainage of Tribal CBM caused by development on federal lands. Operators would be required to provide site-specific analyses prior to field development in areas of potential drainage to Tribal CBM resources. In these analyses, operators must demonstrate whether and to what extent federal CBM production is likely to drain Reservation CBM. The analysis would be used by BLM to determine the timing of CBM production, monitoring requirements, and additional data needs.

If monitoring or reservoir modeling indicates drainage of CBM resources is occurring, the BLM would enter negotiations with the operator and the Tribe to protect the correlative rights of the Tribe. BLM requirements could include reducing production rates, shutting in the well or wells, establishment of communitization agreements, or payment of compensatory royalty.

To protect the correlative rights of the Tribe from state and private CBM development, the BLM would represent the Tribe at MBOGC hearings that set spacing units for the production of CBM resources including state and private lands. The BLM would work with the MBOGC under its existing Memorandum of Understanding to protect Tribal resources that may be affected by state or private permits, or establishment of CBM spacing units adjacent to Tribal resources. Under this alternative, there would be no drainage of tribal CBM resources by federal lease operators. The potential for drainage by fee lands within the reservation boundary and along the exterior boundary would be minimized to the extent possible.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative B with the exception that injection of produced water would not be required. Injection of produced water into a subsurface formation approved by the state would be one water management option available to operators under this alternative and such disposal would not impact other mineral resources. Other produced water management options would be making produced water available for beneficial uses and treating, as needed, produced water before being discharged onto the surface or into bodies of water or used in land applications. Impacts from produced water management options are described in other resource sections, such as hydrology and soils.

Hydrological Resources

Hydrological Resources

Surface water: Some surface waters in the Powder River Basin are of good quality and frequently used for irrigation. Other Rivers are characterized as having fair to poor quality water and may go dry, the waters are used for stock and limited irrigation.

Groundwater: Groundwater is available in stream bottom alluvium, but becomes scarce away from water courses. Coal beds and interlayered sands are the most commonly used aquifers away from riparian areas. Groundwater quality is variable.

Alternative A
No Action (Existing CBM Management)

- Federal:
  - No impacts to surface or groundwater resources
- State:
  - Negligible changes in Tongue River quality and flow.
  - Groundwater drawdown within the immediate vicinity of the CX Ranch
  - Continued beneficial reuse of produced water at the CX Ranch
- Cumulative Impacts:
  - Surface Water:
    Wyoming CBM discharges will result in slight increases in flow and slight changes in water quality in rivers shared between Montana and Wyoming, however downstream uses will not be diminished
  - Groundwater:
    Drawdown from Wyoming CBM and the CX Ranch may extend several miles from development.
  - Beneficial Reuse:
    Wyoming and CX Ranch discharges may increase opportunities for beneficial use.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Surface Water
  - Same as Alternative A.
- Groundwater:
  - Drawn down will occur over large continuous areas
  - Immediate drawdown will be minor. However, as CBM production matures, coal seam aquifer drawdown may extend 4 to 5 miles from the edge of production
  - No change in groundwater quality
- Beneficial Reuse:
  - Same as Alternative A
- Cumulative Impacts:
  - Surface water flow and quality will be the same as Alternative A
  - Montana CBM production and Wyoming will noticeably drawdown coal seam aquifers
  - Groundwater quality in Montana and beneficial reuse will be the same as Alternative A

Alternative C
Emphasize CBM Development

- Surface Water
  - Water quality in some watersheds will be noticeably altered.
  - Flows will be considerably increased.
- Groundwater:
  - Drawdown similar to Alternative B.
  - Alluvial groundwater quality may be altered due to infiltration of untreated production water
- Beneficial Reuse:
  - Same as Alternative A
- Cumulative Impacts:
  - Surface water quality in some watersheds will be noticeably altered.
  - Flows will be considerably increased.
  - Impacts to groundwater drawdown, quality and beneficial reuse will be the same as in Alternative B

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Surface Water
  - Water quality will not be altered.
  - Flows will increase similar to Alternative C
- Groundwater:
  - Drawdown same as Alternative B
  - No groundwater quality impacts
- Beneficial Reuse:
  - Increased beneficial uses, estimated at 20% of production
- Cumulative Impacts:
  - Surface water quality will be slightly altered due to Wyoming CBM discharges.
  - Surface water flows will be similar to Alternative C
  - Groundwater drawdown and quality changes will be the same as in Alternative B

Alternative E
Preferred CBM Development Alternative

- Surface Water
  - Water quality will be slightly altered, however beneficial uses will not be diminished
  - Flows will moderately increase
- Groundwater:
  - Drawdown same as Alternative B.
  - Alluvial groundwater quality may be altered due to infiltration of untreated production water
- Beneficial Reuse:
  - Required Water Management Plans from all operators will result in Beneficial reuse of approximately 20% of production
- Cumulative Impacts:
  - Cumulative impacts will be dependent on MDEQ numerical standards
  - Surface water quality will be slightly altered however downstream uses will not be diminished
  - Surface water flows will be moderately increased
  - Groundwater drawdown will be similar to Alternative B
  - Shallow groundwater quality may be slightly altered

The key water quality parameters for predicting the potential effects of CBM development on irrigated agriculture are sodicity (as sodium adsorption ratio, SAR) and salinity (as electrical conductivity, EC). The MDEQ believes that irrigated agriculture is the most sensitive beneficial use for surface waters in the study area, thus protection of irrigated agriculture will also be sufficient to protect all other beneficial uses. Instream numerical targets for these parameters are used to model environmental impacts.

Ideally, those numerical targets could be compared to numerical water quality standards. However, there are no final, numerical water quality standards for these parameters applicable to the waterbodies addressed in this EIS. The regulatory entities with jurisdiction (MDEQ, EPA, and the Northern Cheyenne Tribe) for the potentially affected waterbodies have begun the process of quantifying the SAR and EC values they believe would protect irrigated agriculture in these basins.

In May 2002, the Northern Cheyenne Tribe adopted numerical water quality standards for SAR and EC applicable to waters within the Reservation. Although these tribal standards do not have Clean Water Act regulatory status until approved by the EPA, the adopted numerical standards do set out the Tribe's considered determination of the water quality needed to protect irrigated agriculture on the Reservation (Northern Cheyenne Tribe 2002).

The State of Montana has initiated a process for developing and adopting water quality standards for SAR and EC. Within the Montana process, MDEQ has proposed two approaches: one approach would assign a single set of SAR and EC values to each of the potentially affected waterbodies (Option 1) and the second approach would assign a series of values applicable to specific segments of those waterbodies (Option 2). For each approach, the MDEQ lists a range of values that might be considered by the Board of Environmental Review.

In addition, within the Montana process, a coalition of environmental and irrigation interest groups, collectively known as the "Petitioners," has proposed its own set of numerical SAR and EC standards. The Petitioners' proposal takes an approach similar to the MDEQ's option 2. The Petitioners include the Tongue River Water Users Association, the Tongue and Yellowstone Irrigation District, the Buffalo Rapids Irrigation Project, and the Northern Plains Resource Council.

Therefore, four sets of numerical standards for SAR and EC are now under consideration for applicable to the waterbodies addressed in the EISs: the Northern Cheyenne Tribe's adopted water quality standards; Montana's Option 1; Montana's Option 2; and the proposed standards of the Petitioners. Together, these four sets of values present a wide range of numerical values, and are shown in Table 4-18.

Table 4-18 summarizes the highest and lowest limits proposed by the petitioners to the Montana DEQ standards process. The proposed limits apply to individual watersheds and have been suggested for seasons of the year. For example, different limits have been proposed for the irrigation season but since a single irrigation season has not been agreed upon, the limits have been lumped together. The proposed limits are fully summarized in the Hydrology Appendix.

Because the water quality standards development process is still underway for key waterbodies addressed by the EISs, it would be inappropriate for the lead or cooperating agencies to select specific numerical values within the range of proposals and to apply only those selected values in evaluating potential impact scenarios. Instead, the full range of proposed SAR and EC limits are compared with the modeling outputs. The information is presented so that the reader may compare any discharge alternative with the proposed SAR and EC values.

When evaluating the various SAR and EC values, consider the following points:

- It should not be assumed that any SAR or EC value within the displayed range will eventually be determined to provide an appropriate level of protection for the existing or anticipated irrigated agricultural uses in these basins.
- The water quality standards process involves adoption by a state or Tribe, followed by EPA review and approval, and it is important to note that state- or Tribally-adopted standards would not have Clean Water Act regulatory meaning until approved by EPA.

TABLE 4-18
SUMMARY OF PROPOSED LIMITS FOR MONTANA SURFACE WATER

	Most Restrictive Proposed Limit (MRPL)		Least Restrictive Proposed Limit (LRPL)	
Stream	**SAR**	**EC**	**SAR**	**EC**
Tongue, Little Bighorn, and Bighorn, Yellowstone	0.5	500	10.0	2500
Rosebud	1.0	500	10.0	2500
Little Powder	3.0	1000	10.0	3000
Powder	2.0	1000	10.0	3200

- The water quality standards process is still underway, and it is not possible to predict the outcome of that process.

While the eventual outcome of this water quality standards process is uncertain, it is useful to note the specific SAR and EC values contained in Table 4-18. The values shown in Table 4-18 were determined from all of the proposed standards currently before the Montana Board of Environmental Review. A complete listing of the proposed standards is located in the Hydrology Appendix of this EIS. These SAR and EC values were developed with assistance from advisors with expertise in the area of salinity and sodicity effects on irrigated agriculture. Therefore, it would not be unreasonable to view these values as providing a fair estimate of the range of SAR and EC values that may eventually be judged as providing an appropriate level of protection for irrigated agriculture in these basins.

The Ayers and Westcot EC/SAR relationship is used to determine the effect of irrigation waters on the infiltration capacity of soils. This relationship recognizes that as salinity increases the potential impacts of SAR decrease. This relationship is not unbounded, however, because of the potential impact of rainfall on sodic soils. Rainfall can cause SAR problems in surface soil because of the differential way in which EC and SAR respond to a rain event (significant lowering of the EC and little change in the SAR). This rain-on-sodic-soil problem is addressed in a number of the standards proposals (see Hydrology Appendix) through adoption of an absolute maximum SAR (i.e., the standard “caps” the Ayers and Westcot EC/SAR relationship).It will be important to be mindful of an upper bound on the Ayers and Westcot relationship in reviewing the conclusions reached in the alternatives analyses in this document. This may help explain situations where the MRPL (or perhaps, the LRPL) shows a potential effect, where the Ayers and Westcot diagram indicates no reduction in infiltration. This relationship is used as criteria against which the results of the surface water quality are compared.

Another factor to consider in applying these SAR and EC values is that there is a significant distinction to be made between the modeling approach applied to alternatives analysis and the approach that eventually will be used in calculating discharge limits for future, specific CBM projects:

- The modeling approach used in this document begins with an assumed water management method for all the reasonably foreseeable CBM development in Montana and Wyoming and, applying a series of assumptions (see discussion below), predicts a resultant instream cumulative water quality. That predicted water quality modeling output is then displayed against the full range of proposed SAR and EC limits, with no assessment as to the appropriateness of any specific value within that range.
- The water quality-based approach that is actually used to calculate future Montana Pollutant Discharge Elimination System (MPDES) permitting requirements will begin with appropriate and specific instream water quality standards. Through the total maximum daily load (TMDL) process, those standards will be translated into discharge limits for specific CBM projects.

The standards serve as the regulatory basis for controlling CBM discharges, and the water quality-based permitting approach that implements these standards is different from the predictive modeling approach used in this EIS.

The water quality-based approach begins with a desired instream water quality and, using that as the target, calculates the CBM discharge limits needed to ensure the desired instream water quality is achieved. The TMDL process identifies capacity for a waterbody to assimilate substances (maximum load). That capacity then has to be allocated among the appropriate governmental entities along that waterbody. It should be noted that, where a Tribe is one of the appropriate governmental entities, EPA has a trust responsibility to ensure a fair and meaningful portion of the available assimilative capacity is reserved for that Tribe.

The spreadsheet model used in the analysis of impacts for the EIS employs a steady state mass balance approach to estimate concentrations of EC and SAR after stream water and CBM discharged water are mixed. The steady state mass balance approach is commonly used by the EPA in predicting possible effects of point source discharges on receiving waters. Input parameters to the spreadsheet model were developed from analysis of reasonably conservative assumptions, as well as measures of central tendency (typical or mean values).

The Surface Water Quality Analysis Technical Report (SWQATR) lists the input parameters and indicates whether conservative or mid-range values were used in the impact analysis model. The resultant spreadsheet model is considered to provide a conservative, yet reasonable estimate of the impacts of CBM development on surface water quality in the Powder River Basin. The SWQATR also discusses the problems of manipulating sample SAR values (Greystone 2002). It should be noted that this model is meant to be used to compare alternatives, not to predict precise resultant water quality.

Assumptions

CBM development has the potential to impact surface water, surface aquifers, and coal seam aquifers that hold the groundwater resources in the planning and CBM emphasis area. The following assumptions form the framework for analyzing the impacts:

- The maximum volume of CBM water production and discharge is predicted to occur in year 6 of the RFD. All surface water impacts are calculated using this maximum CBM discharge volume.
- All modeling results shown in this EIS are for the low mean monthly stream discharges. 7Q10 discharges are also included in the SWQATR analysis.
- SAR and EC were calculated using a simple flow-weighted mass balance equation. This assumption is strictly correct for EC however it results in an overestimation of SAR. This results in a conservative model of impacts due to CBM discharges.
- To facilitate analysis, a range of water quality criteria is assumed based on the proposals before the Montana Board of Environmental Quality. The states of Wyoming and Montana recognize public concern and, in an effort to protect the water quality within the Powder River Basin, have entered into an 18-month interim memorandum of cooperation. A copy of the interim memorandum of cooperation can be found in the Hydrology Appendix. The interim memorandum of cooperation is intended to specifically protect the downstream quality of the Powder and Little Powder watersheds that enter Montana from Wyoming. The criteria for EC are expressed in monthly maximum values that are not to be exceeded. The two states are also concerned with SAR and bicarbonate, but lack sufficient data. For the Little Powder River, monitoring of the EC, SAR, and TDS will be performed by the state of Montana to determine if these levels change appreciably.

A complete listing of all model assumptions may be found in the SWQATR.

Impacts From Management Common to All Alternatives

Conventional Oil and Gas Production

Conventional oil and gas production can produce large volumes of water that could impact surface and groundwater resources because of the quality of the produced water. Since 1953, the MBOGC has regulated the use and disposal of water produced in association with the production of oil and natural gas to mitigate the potential for impacts to the environment.

The use of surface impoundments is controlled by BLM and the state. BLM permits water disposal pits (surface impoundments) on federal leases. The permitted surface impoundments are those designed primarily for evaporation. Any impoundments constructed in the state, including those involving federal land or minerals, would require approval from the MBOGC. Further, the MDEQ permits any point-source discharges to surface waters (e.g., streams), including those that could result from surface impoundments.

Conventional oil and gas is typically produced from depths below usable aquifers and below coal seams. Regulations require the isolation of oil and gas producing zones from other reservoirs containing possible hydrocarbons or from aquifers that contain usable water. Underground Injection Control (UIC) regulations also require safeguards to isolate injection zones from other zones that contain hydrocarbons and from aquifers that contain usable, or potentially usable quality water (i.e., groundwater containing less than 10,000 mg/l of total dissolved solids).

Produced water that has a TDS concentration of less than 15,000 mg/l can be discharged to permitted surface impoundments. As a result of the existing regulations, the impact on surface water and groundwater resources from conventional oil and gas production is minimal.

Impacts from Management Specific to Each Alternative

Impacts on Hydrological Resources under the five management alternatives are summarized in Chapter 2, Table 2-3, Comparison Summary of Impacts. The impacts are discussed in detail for the major watersheds in the following sections.

Alternative A—No Action (Existing CBM Management)

Alternative A consists of the existing CBM management scenario, with the addition of the forecast future development of CBM resources in the Wyoming portion of the Powder River Basin that occurs upstream Montana. Based upon discussions with the Wyoming offices of BLM and the WYDEQ, it is assumed throughout this EIS that Wyoming's Alternative 2A will be adopted for Wyoming.

Under Montana's alternative A, only those producing wells that currently exist in the CX Ranch field will produce CBM and water in Montana. Other CBM exploration wells could be drilled on state and fee minerals, but would not be allowed to produce gas or water. Rosebud Creek, the Bighorn River, and Mizpah Creek would not receive any CBM produced water under this alternative, as they would not be affected by Wyoming's production. However, an analysis of their flow volumes and water chemistries are included for comparison to other alternatives. The Tongue River, Powder River, and Little Powder River watersheds could have impacts from CBM development due to Wyoming production.

Exploration

CBM exploration activities on state, fee, or BLM-administered mineral estates would result in only slight effects on groundwater and would not affect surface waters. Exploration wells would be tested but not commercially produced. Testing of CBM exploration wells involves pumping the wells for several weeks; however, the volume of coal seam aquifer groundwater removed is moderate and is not expected to impact nearby water wells or springs. Recovered produced water and drilling wastes would be contained in impoundments or tanks and would be disposed of in accordance with regulations for conventional oil and gas wastes.

Production

CBM water production would continue to be allowed within the CX Ranch CBM field, but at a level approximately 20 percent above current conditions; this would constitute a total of 250 producing wells. An increase in soil erosion resulting from the construction of additional well pads and lease roads could occur, adding to the suspended sediment load of area surface waters.

The 250 producing CBM wells at the CX Ranch field would also affect groundwater resources within the producing coal seam aquifers. Production at this level would result in increases to groundwater drawdown levels within the three coal seam aquifers being produced. Groundwater drawdown within the coal seams currently extends at least 1.8 miles beyond the edge of CBM production at the CX Ranch field. Increasing the size of the field by approximately 20 percent would add to the drawdown.

Two-dimensional groundwater modeling has indicated that drawdown of coal seam aquifers may extend up to 14 miles from the edge of a producing field after 20 years of production (Wheaton and Metesh, 2001). Three dimensional modeling of the East Fork of Hanging Woman Creek, which takes into account vertical leakage, indicates that 20 feet of drawdown in the coal seams would extend 4 to 5 miles from the producing field. (Wheaton and Metesh, 2002). Effects on groundwater could also take the form of dry springs that issue from methane-productive coal seams caused by coal seam aquifer drawdown. Aquifers other than the produced coal seams, such as alluvium or sandstone bedrock aquifers, are estimated to be less vulnerable to drawdown from CBM production due to low vertical hydrologic conductivity in the Tongue River member of the Fort Union Formation. This will limit the vertical movement of groundwater (Wheaton and Metesh, 2002).

Water released to unlined surface impoundments in alluvial materials has the opportunity to infiltrate into shallow aquifers, causing measured impacts to the depth to water in the alluvial aquifers and alluvial wells. The introduction of this water to the aquifer may improve or degrade the usability of these waters, depending on site specific conditions. Infiltration basins constructed out of drainages and away from outcrops should recharge bedrock aquifers. This recharge is not expected to appreciably alter groundwater chemistry.

Surface Water Analysis

Tongue River

The Tongue River has its headwaters in the Bighorn Mountains to the south. This river could receive CBM impacts from current and future development in both the Wyoming and Montana portions of the Powder River Basin. The detailed input data, calculation of impacts, and summary of impacts from Alternatives can be reviewed in the SWQATR. Table 4-19 displays the impacts for the three stream stations analyzed along the Tongue River in Montana.

The Tongue River is not expected to be impacted by direct CBM water discharges from Wyoming (see WYDEQ memo located in Hydrology Appendix). The Wyoming EIS and this EIS do predict that the Tongue River could be impacted by approximately 15 percent of the produced water volume through accidental releases and through recharge of the river from infiltration into shallow aquifers. In addition, other impacts to the Tongue River under Alternative A could result from the approximately 250 CBM wells in the CX Ranch field. For this analysis, the CX Ranch discharge was split between the Decker station and the Birney station.

During the minimum mean monthly flow, these impacts increase the flow volume and EC value in the stream by only a few percentage points, but increase the SAR value in the river water by up to 133 percent (1.4 units). The resultant mixed stream water and CBM water can be compared to the following surface water criteria:

- Most Restrictive Proposed Limit (MRPL): These limits are set at a SAR of 0.5 and an EC of 500 micro-Siemens per centimeter (µS/cm) for the Tongue River. Since the Tongue River naturally exceeds these limits, it cannot receive any CBM discharge if these limits are adopted. The forecasted impacts under Alternative A are, therefore also in excess of the these proposed limits.

- Least Restrictive Proposed Limit (LRPL): These proposed limits would be set at a SAR of 10 and an EC of 3,000 µS/cm. These limits would not be exceeded during either the Minimum Mean Monthly or the 7Q10 (lowest flow that would be expected for 7 consecutive days over a 10 year period) flows under Alternative A.

- Northern Cheyenne Proposed Standards: Surface water alteration forecasted under Alternative A would be at or below the Tribe's proposed limits during the irrigation season (April through October) but would exceed the proposed standard for SAR during the non-irrigating season by up to 0.52 SAR.

- Ayers and Westcot 1985 water quality plot: The SWQATR displays the SAR versus EC plots for the Tongue River. These plots show that at no time would the water cause infiltration impacts to soils under irrigation under Alternative A.

- The surface water volume and quality in the Tongue River is slightly altered by CBM discharges under Alternative A; however, beneficial uses are not anticipated to be impacted.

Powder River

The Powder River has its headwaters in the Wyoming portion of the Powder River Basin, and as such would receive CBM water from development in Wyoming. As no Montana CBM wells are assumed to discharge into the Powder River under Alternative A, all forecasted alterations would be due to CBM development in Wyoming. The analysis conducted at the Locate, Montana, station includes all CBM discharges into the Powder, Little Powder, and Mizpah, cumulatively. Table 4-20 summarizes these impacts.

The Powder River is expected to be affected by Wyoming CBM development, resulting in an appreciable alteration of surface water chemistry. Only

TABLE 4-19
EFFECTS ON SURFACE WATERS OF THE TONGUE RIVER UNDER ALTERNATIVE A

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative A		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Tongue River at Stateline Near Decker	0.5	500	10	2500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	0.5	500	10	2500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Montana	0.5	500	10	2500	207	1.36	1016	214	2.5	1058

TABLE 4-20
EFFECTS ON SURFACE WATERS IN THE POWDER RIVER UNDER ALTERNATIVE A

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative A		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Powder River at Moorhead	3	1000	10	3200	145	4.65	2154	224	10.7	2230
Powder River at Locate	3	1000	10	3200	143	4.61	2287	236	11.36	2320

Wyoming CBM development would affect the river. Flow volumes are forecasted to increase by approximately 54 percent SAR would be increased by approximately 130 percent, and EC would be increased by 3 to 4 percent. The resultant mixed stream water quality can be compared to the available surface water criteria:

- MRPL: The Powder River is naturally well above MRPLs for SAR and EC limits. Therefore, it could not receive any CBM discharge if these limits are adopted. The forecasted impacts under Alternative A would render the Powder River even farther in excess of these proposed limits.
- LRPL: EC and SAR limits would not be substantially exceeded except during the lowest flow (7Q10) periods under Alternative A.
- Ayers and Westcot 1985 water quality plot: The SWQATR includes SAR vs EC plots to document that at no time except 7Q10 low flow will the mixed water cause infiltration impacts to soils under irrigation.

The surface water volume and quality in the Powder River would be affected by discharges from Wyoming CBM development under Alternative A. Irrigators currently tend to use Powder River water for irrigation during high flow events. The SWQATR shows that during the irrigation season, the SAR would increase

77 percent and during the non-irrigation season would increase 100 percent. EC would be expected to increase only approximately 4 percent during both the irrigation and non-irrigation seasons at the Moorhead station. Flow would increase approximately 15 percent during the irrigation season and approximately 29 percent during the non-irrigation season. During the 7Q10 flow the Powder River contains very little water, and the water in the river is too saline to be used for irrigation. Therefore these changes in water quality are not expected to impact the current beneficial uses of these waters.

The Little Powder River

The Little Powder River has its headwaters in the Wyoming portion of the Powder River Basin, and as such it is expected to receive CBM water from development in that state. All analyses for this stream are conducted at the Weston, Wyoming, station, near the stateline. At this station, no effects are possible from Montana CBM under any alternative. Table 4-21 illustrates the effects expected on the Little Powder River from CBM development under Alternative A.

Only Wyoming CBM discharges affect the river under this alternative. During minimum mean monthly flows, this development will cause the flow to increase by 515 percent, the EC to decrease by 51 percent, and the SAR to increase by 50 percent. The resultant mixed stream water and CBM water can be compared to the following surface water criteria:

- MRPL: The Little Powder River is naturally above these SAR and EC limits and could not receive additional CBM discharge if these limits were adopted. The forecasted effects under Alternative A renders the stream water farther in excess of these limits.
- LRPLs: EC and SAR limits are exceeded only during the lowest flow periods (7Q10) under Alternative A.
- Ayers and Westcot 1985 water quality plot: The SWQATR plots suggest that during the mean monthly flows for 2 months of the year (November and December), the mixed water may cause infiltration impacts to soils under irrigation. The elevated SAR may reduce soil permeability, thereby reducing the rate of water infiltration.

The surface water volume and quality in the Little Powder River would be slightly impacted by discharges from Wyoming, resulting in no impacts to downstream users. Irrigators currently tend to use Powder River water for irrigation during high flow events. The SWQATR shows that during the irrigating season (April through October), the SAR increased 33 percent and the EC actually decreased by 33 percent. During the non-irrigation season, the SAR increased by 33 percent and the EC decreased by an average of 49 percent. Wyoming discharges of CBM water would increase surface water flow into the Little Powder River by more than six times, causing major changes to stream conditions including increased flow, channel erosion, and sedimentation during historically low-flow periods.

Mizpah Creek

The Mizpah contains low quality water that has limited irrigation use, but can be used for stock watering and wildlife. This watershed is not expected to be affected by CBM activity under Alternative A, as shown on Table 4-22. This stream water can be compared to the following surface water criteria:

TABLE 4-21
EFFECTS ON SURFACE WATERS OF THE LITTLE POWDER RIVER UNDER ALTERNATIVE A

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative A		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Little Powder	3	1000	10	3000	3	6.9	3300	16	10.4	1606

TABLE 4-22
EFFECTS ON SURFACE WATER OF MIZPAH CREEK UNDER ALTERNATIVE A

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative A		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Mizpah Creek at Mizpah	2	1000	10	3200	0.26	16.6	3503	0.26	16.6	3503

- MRPL: Existing stream water is well in excess of these limits for both SAR and EC. The stream could not receive CBM water unless the water was of better quality than the stream, if these limits were adopted.
- LRPL: Except for two months out of the year, average water quality is in excess of SAR limits but within the EC limits for 11 months of the year.
- Ayers and Westcot 1985 water quality plot: Except for 3 months out of the year, the average existing water exceeds irrigation water quality limits set by Ayers and Westcot.

All current uses of these waters would be maintained under Alternative A.

Bighorn and Little Bighorn Rivers

These rivers carry high quality water from the Bighorn Mountains north into Montana. No CBM wells in Wyoming or Montana are expected to impact these rivers under Alternative A. Stream water quality and flow volume are expected to remain unchanged. As shown on Table 4-23, the following expected results can be compared to the following surface water quality criteria:

- MRPL: Existing stream water monthly averages at Wyola except during two months is in excess of these limits for SAR; likewise, the existing stream water is in excess of these EC limits for all but three months of the year. The other two stations are in excess of these limits throughout the year.

  The stream could not receive CBM water unless the water was of better quality than the stream, if these limits were adopted.
- LRPL: The existing stream water monthly averages do not exceed these limits during the year at any of the three stations.
- Ayers and Westcot 1985 water quality plot: The monthly average existing water quality at all three stations is within irrigation water quality limits set by Ayers and Westcot.

All current uses of these waters would be maintained under Alternative A.

Rosebud Creek

This creek drains part of the Powder River Basin in Montana. No CBM water would be discharged into this creek; therefore, stream water quality and flow is unchanged as shown on Table 4-24. These expected results can be compared to the following surface water quality criteria:

- MRPL: Throughout the year, existing stream water monthly averages at both stations are in excess of these limits for SAR and EC. The stream could not receive CBM water unless the water was of better quality than the stream, if these limits are adopted.
- LRPL: The monthly average existing stream water does not exceed these limits at either of the gauging stations.
- Ayers and Westcot 1985 water quality plot: The monthly average existing water quality at both stations is within irrigation water quality limits set by Ayers and Westcot.

TABLE 4-23
EFFECTS ON SURFACE WATERS OF THE LITTLE BIGHORN AND BIGHORN RIVERS UNDER ALTERNATIVE A

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative A		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Little Bighorn River at Wyola	0.5	500	10	2500	110	0.53	548	110	0.53	548
Little Bighorn at Hardin	0.5	500	10	2500	123	0.99	768	123	0.99	768
Bighorn River at Bighorn	0.5	500	10	2500	1523	2.08	962	1523	2.08	962

All current uses of these waters would be maintained under Alternative A.

Yellowstone River

The Yellowstone River drains all of the Montana watersheds in the Powder River Basin. As such it provides an analysis of the cumulative effects forecasted from CBM development in Montana and Wyoming in the Bighorn, Rosebud, Tongue, and Powder watersheds.

Only the station at Sidney is expected to receive CBM related effects under Alternative A. These effects are in the form of discharge from CX Ranch in Montana and Wyoming CBM wells. After mixing, the flow of the Yellowstone would be increased by 1 percent, the SAR would be increased by 13 percent, and the EC would be increased by 1 percent. The resultant mixed stream water, shown on Table 4-25, can be compared to the following surface water criteria:

- MRPLs: The Yellowstone River is naturally above this SAR limit and could not receive additional CBM discharge if these limits were adopted. The forecasted effects under Alternative A render the stream water farther in excess of these limits.
- LRPLs: These EC and SAR limits would not be exceeded during even the lowest flow periods under Alternative A.
- Ayers and Westcot 1985 water quality plot: The SWQATR's plots predict that the mixed water would not cause infiltration impacts to soils under irrigation under Alternative A.

TABLE 4-24
EFFECTS ON SURFACE WATER OF ROSEBUD CREEK UNDER ALTERNATIVE A

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative A		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Rosebud Creek at Kirby	0.5	500	10	3000	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	0.5	500	10	3000	8.42	4.84	1780	8.42	4.84	1780

TABLE 4-25
EFFECTS ON SURFACE WATER OF THE YELLOWSTONE RIVER UNDER ALTERNATIVE A

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative A		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Yellowstone at Forsyth, Montana	0.5	500	10	2500	5820	1.99	745	5820	1.99	745
Yellowstone at Sidney, Montana	0.5	500	10	2500	5764	2	870	5805	2.26	881

The surface water volume and quality in the Yellowstone River would not be appreciably affected by discharges from Montana and Wyoming under Alternative A. Discharges of CBM water would only slightly increase surface water flow in the Yellowstone River, causing negligible changes to physical stream conditions, even during historically low-flow periods.

Abandonment

Abandoned well pads would be restored to their original condition with the only effect being the short-term increase in suspended sediments in area surface waters resulting from the increased erosion of disturbed soil. CBM wells that are not produced would be abandoned in accordance with existing regulations and with procedures for the abandonment of oil and gas wells to protect groundwater resources, or converted to monitoring wells as deemed necessary.

Crow Reservation

The Crow Reservation can expect few effects from CBM development within Montana under this alternative. Continued development is expected in the CX Ranch field near Decker. Groundwater drawdown is expected to extend approximately 4-5 miles from the CX Ranch development. This drawdown could impact water wells and springs that receive water from these coal seams on tribal land. Scattered CBM exploration drilling and testing would have only slight effects on reservation coal seam aquifers.

CBM development in Montana and Wyoming could drain groundwater and methane from coal seams under the Reservation.

If Wyoming CBM operators are able to discharge CBM water into either the Little Bighorn or Bighorn watersheds, there could be effects to surface waters on the Reservation. However, there are currently no proposals to develop CBM in these watersheds in Wyoming.

Northern Cheyenne Reservation

The Northern Cheyenne Reservation can expect effects to surface water by CBM development outside the reservation under this alternative. The CX Ranch has a permit to discharge CBM water to the Tongue River and this would continue under this alternative. Effects to surface water are described in detail in the surface water section of this alternative, and in the SWQATR. Groundwater drawdown is expected to extend approximately 4-5 miles from the CX Ranch development. This groundwater drawdown effect would not reach the Northern Cheyenne Reservation.

CBM development in Wyoming is not expected to affect groundwater under the Reservation. Currently, the WYDEQ's policy is to not allow direct discharge of CBM waters into the Tongue River watershed. If the current policy in Wyoming changes and operators are able to discharge water into the Tongue River, the quality of the water in the Tongue River on the reservation would be affected. Meanwhile, accidental releases and unintended infiltration under storage ponds could contribute some effect to the Tongue River from Wyoming.

Conclusion

Montana-based CBM development, conventional oil and gas development, and surface coal mining would have the potential for effects to surface water and coal seam aquifer groundwater resources in Montana. Few CBM wells would be drilled and impacts would be limited in both magnitude and geographic extent. CBM development at the CX Ranch field could expand, although surface discharge volume to the Tongue River would be controlled by an existing permit. Groundwater impacts to methane-productive coal seam aquifers from the CX Ranch are expected to extend 4-5 miles from the edge of development. Scattered CBM exploration and testing would have a slight effect on static water levels in coal seam aquifers, but would not affect surface waters.

Coal seams that are the targets of surface coal mining operations typically contain groundwater. As a result of the presence of this water, coal mine operators must remove this water as it collects in the bottom of the pits in order to mine the coal. Map 4-2 shows coal mines in the planning area. These mines cover approximately 50,000 acres where coal seam aquifers have been impacted either by the removal, partial depletion, or total depletion of groundwater. In the mining areas around Colstrip and Decker, coal seam aquifers have been drawn down by as much as 75 feet near the coal mines, with a radius of impact of up to 4 miles from the mines (Wheaton and Metesh 2001). The discharge of groundwater pumped from mine pits would also affect surface water depending on the quality of groundwater near the mine and the quantity of groundwater discharged. In instances where the mines do not discharge because all of the recovered groundwater is used, there would be no direct impacts to surface water quality. Much of the groundwater pumped from the mine pits would be stored and used to control dust on roads, truck, and train car loading areas, and the mine face.

Following the release of the Wyodak EIS (BLM 1999b), the RFD for the Wyoming portion of the Powder River Basin was reassessed, and a new RFD was issued (BLM 2001a). This more recent study indicates that the total number of CBM wells in the Wyoming portion of the Powder River Basin may approach 50,000 (BLM 2001a). An EIS using this level of development is in progress for Wyoming,

Groundwater resources in Montana's coal seam aquifers could be affected by CBM production in Wyoming. CBM-producing wells in northern Wyoming would cause a drawdown of coal aquifers on adjacent land, with groundwater drawdown possibly extending northward into Montana.

Given the groundwater modeling results and related assumptions, if CBM fields were located in Wyoming adjacent to the border with Montana, it can be expected that groundwater levels within coal seam aquifers would be drawdown 20 feet at 4-5 miles into Montana. Drawdown impacts of this magnitude would result in impacts on private lands, the Crow Indian Reservation, state-owned lands, and federal lands controlled by BLM. Cumulative groundwater impacts to coal seam aquifers would be largest near CX Ranch and close to the Wyoming border.

Depending on the surface water quality limits adopted by the Montana Board of Environmental Review, cumulative surface water impacts from Wyoming and Montana CBM development under Alternative A could curtail the surface discharge of CBM water in Montana. If Wyoming CBM development reaches expected levels, Montana watersheds could be impacted to the point where water quality criteria (MDEQ 2001c) could prohibit CBM discharge. For this impact analysis, it is assumed that the Wyoming Alternative 2A would be adopted. In addition, it is assumed that the WDEQ Updated Permitting Options for CBM Permit Applications dated 12/10/2001 will remain in effect (Hydrology Appendix). It should also be noted that there are currently agreements in place between the Montana and Wyoming DEQ offices which should protect the Tongue, Powder and Little Powder rivers from having all of their assimilative capacity used by Wyoming's CBM operators.

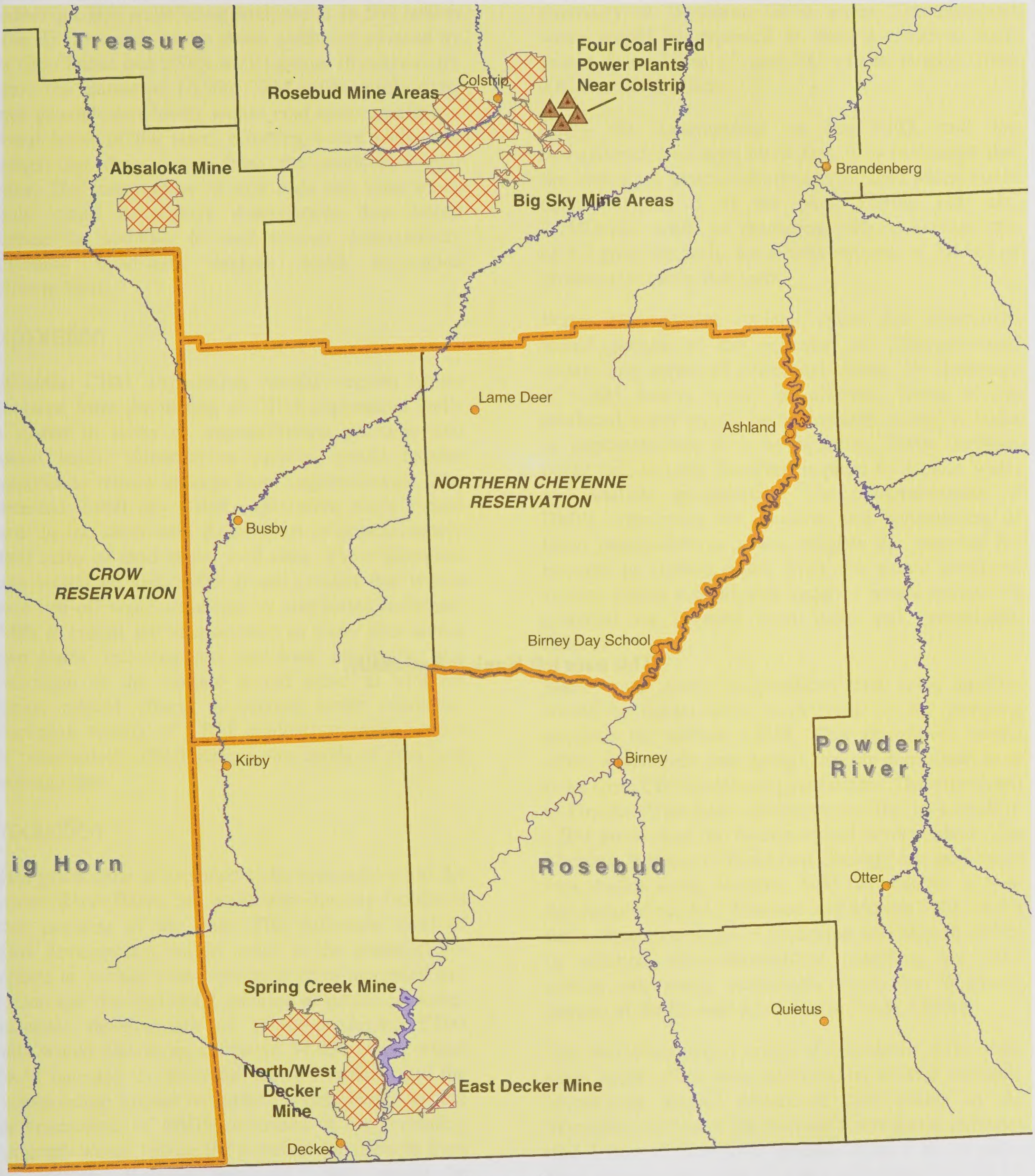
Surface water discharge permits that limit the quantity and quality of discharged CBM water would mitigate the impacts from Wyoming CBM production and from expanded CX Ranch production. Mitigation agreements would be needed to replace water lost from drawdown of groundwater within aquifers and springs impacted by CBM production. If no replacement water is available for mitigation, there may be a need to restrict the volume of water produced.

Beneficial reuse of CBM water is expected to continue in the vicinity of the CX Ranch field as well as other areas near the Wyoming-Montana border. The increased flow of water in some streams may allow increased utilization of the mixed water if quality is appropriate. As there would be little CBM water produced under this alternative, there are no anticipated impacts to the beneficial uses of surface waters.

Alternative B— Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Alternative B consists of full-scale development of CBM with water produced from CBM exploration wells stored in tanks or impoundments, and all water produced from CBM production wells to be injected into approved subsurface zones other than the coal seam from which it was produced. No CBM water would be discharged to the surface. The number of

Map 4-2: Location Map, Regional Coal Mines


Treasure
Rosebud Mine Areas
Colstrip
Four Coal Fired
Power Plants
Near Colstrip
Absaloka Mine
Brandenberg
Big Sky Mine Areas
Lame Deer
Ashland
NORTHERN CHEYENNE
RESERVATION
Busby
CROW
RESERVATION
Birney Day School
Kirby
Birney
Powder
River
ig Horn
Rosebud
Otter
Spring Creek Mine
Quietus
North/West
Decker
Mine
East Decker Mine
Decker

Legend

5 0 5 Miles

5,000 0 5,000 10,000 Meters

N W E S

- ● Cities
- — Rivers
- ▨ Coal Mines
- ▭ Native American Reservations

DATA SOURCES

County Boundaries: 1:100,000 scale, Counties, Montana State Library/NRIS, Helena, Montana.
Cities: 1:100,000 scale, Cities, Montana State Library/NRIS, Helena, Montana.
Mines: Montana Bureau of Mines & Geology.
Otter Creek Site: EMRIA Report #1, 1975.

This page left blank intentionally.

producing CBM wells being analyzed is 16,500, which is the RFD number minus those wells not covered by this EIS (Tribal and USFS wells) minus 10 percent dry holes. The estimated 16,500 CBM wells would draw down groundwater levels within coal seam aquifers in several areas of the state, affecting water wells and springs that draw water from the productive coal seams. The construction of well pads and lease roads would result in surface disturbances that would increase the potential for soil erosion, consequently increasing short-term surface water suspended sediment loads.

Exploration

Full-scale CBM exploration would require water generated from the testing of CBM exploration wells be stored in tanks or impoundments on state and federal lands. Construction permits would require measures to reduce leakage from impoundments. The estimated 2,000 dry CBM exploration wells would result in the short-term disturbance of approximately 2,000 acres of land at the well sites. These disturbed acres would be vulnerable to soil erosion that would cause run-off water impacted by suspended sediment. BMPs to curtail soil erosion such as water bars across lease roads, relieving and mulching cut-banks, and restoration of the surface would serve to mitigate erosion related effects to surface water resources. Short-term testing of CBM exploration wells would not substantially affect static water levels of area coal seam aquifers

Production

CBM production is expected to be concentrated in the Powder River Basin, but could also develop locally in other portions of the state. This full-scale level of CBM development would result in the potential for impacts to surface water resources from increased soil erosion and the accidental releases of produced water. Full-scale development of 16,500 producing CBM wells would disturb an estimated 54,000 acres, which would increase the potential for soil erosion and the corresponding impact to surface water. However, the implementation of BMPs described in the preceding paragraph would reduce the potential for impacts from soil erosion. Because produced water would be disposed by injection into deep aquifers, surface water quality effects are predicted to be the same as Alternative A, and beneficial uses would not be impacted.

The projected 16,500 production wells would generate an estimated average of 2.9 billion cubic feet of produced water per year over 20 years. CBM water produced in Montana is expected to be similar in chemistry to Wyoming CBM water. The produced water would be expected to have a range of SAR values from 22 to 47 and EC values ranging from 2,077 to 3,042 µS/cm.

Using the assumptions in the RFD, and the extrapolated discharge trend line, it is calculated that the maximum annual volume of produced water would occur in year 6 of the plan. During year six, 7,750 wells would be producing with an average rate of 6.2 gpm per well, for a total volume of 3.4 bcf of produced water in that year.

Water management options under this alternative would consist of the injection of CBM-produced waters into approved subsurface zones. No discharge of CBM waters would be allowed. Some of the produced water would be temporarily stored in tanks or impoundments prior to injection. These facilities could fail, causing localized impacts to surface water and shallow groundwater. The implementation of BMPs concerning the location and construction of these impoundments would mitigate the potential for impacts to surface water from the stored produced waters. Berms around tank batteries would reduce the potential for impacts from leaks and catastrophic failures.

Static water levels in produced coal seam aquifers would be drawn down as a result of the pumping required to produce CBM. This drawdown would affect water wells and springs that are completed in or issue from CBM-producing coal seams. The drawdown of Powder River Basin coal seam aquifers as a result of CBM production has been modeled several times. The Montana Bureau of Mines and Geology has performed two studies using Montana field parameters—a two-dimensional model (Wheaton and Metesh 2001) and a three-dimensional model (Wheaton and Metesh 2002). In addition, three-dimensional modeling has been carried out using parameters from the Wyoming portion of the Powder River Basin (BLM 1999a).

The maximum lateral extent of drawdown within coal seam aquifers has been estimated by several methods. Monitoring around dewatered coal mines in the Wyoming portion of the Powder River Basin indicates that 5 feet of drawdown extends from 2 to 14 miles from mined areas after 15 years of mining (US BLM, 1999). 3D groundwater modeling conducted in conjunction with the WYODAK EIS (US BLM, 1999) predicted 5 feet of drawdown at distances from 10 to 22 miles from the edge of production. 2D groundwater modeling, which should represent the maximum limit of drawdown due to vertical leakage being ignored, was conducted in conjunction with this EIS. This 2D modeling indicated that 5 feet of drawdown within the

Powder River Basin may extends up to 11 miles from the edge of CBM production (Wheaton and Metesh, 2001). 3D groundwater modeling of the East Fork of Hanging Woman Creek was also conducted in conjunction with this EIS. This model indicates that the maximum extent of the 5-foot drawdown contour extends up to 7 miles from the edge of production (Wheaton and Metesh, 2002). Based upon this information, the five foot drawdown contour that would likely result from CBM development would extend from 7 to 11 miles from the pumped area. The range of estimates however extends from 2 miles to 22 miles from the pumped area.

These differences between results are not unexpected, and serve as a point to emphasize the site-specific nature of the geology in the Powder River Basin. As the hydrology is fundamentally linked to the geology, it will be critical to manage drawdown related impacts in an adaptive manner, using site-specific data gathered through monitoring. Management alternatives may include re-supply of water to individuals who have springs or wells effected by drawdown (as required by the Powder River Basin controlled groundwater area designation), modification of production plans to limit drawdown impacts to springs where such springs have been determined to be culturally significant, or critical to wildlife, or the installation of a hydrologic barrier (such as injection wells) that will limit the lateral extent of drawdown.

The uncertainty associated with modeling a 5-foot drawdown contour is not insignificant since output of this nature is very sensitive to slight changes in the input parameters used for the model. 5 feet of drawdown would also not, in most cases, impact the usefulness of a well. Since a 20-foot drawdown contour can be modeled with a much higher degree of certainty, and it is a more realistic parameter for evaluation of impacts, the 20-foot drawdown contour is used in this analysis to represent the extent of the drawdown which results from CBM development. Based upon the 3D model prepared in conjunction with this EIS, the 20-foot contour can be expected to extend 4 to 5 miles from the edge of CBM production.

A hydraulic barrier would most likely take the form of a line or system of injection wells. These wells would inject water into the coal aquifer being developed to limit the lateral extent of groundwater drawdown, and prevent that drainage of methane and groundwater resources. It should be emphasized that the installation of a hydraulic barrier is just one of many methods that may be employed to prevent drainage. The feasibility and necessity of installing such a barrier will be addressed on a case-by-case basis. The water injected by a hydraulic barrier system would most likely be obtained from nearby CBM production wells finished in the same aquifer as the injection wells. Class V permits for injection of produced water with less than 3, 000 mg/l TDS would generally need to be obtained from EPA Region VIII for such a project. Other permit requirements may apply depending on the quality of the injected water and quality of the water in the target coal seam.

Coal seam aquifers that do not produce methane may also experience drawdown, but to a much lesser extent because of the confined nature of the individual producing coal seam aquifers (Wheaton and Metesh 2002). Wells and springs that issue from such aquifers would correspondingly be less profoundly affected. Surface aquifers such as stream alluvium and river terraces would show even less effect from CBM withdrawal. The three-dimensional modeling performed for this EIS shows a maximum drawdown in surface aquifers of 6 feet approximately 1 mile outside the CBM field (Wheaton and Metesh 2002).

During the 20-year planning period for CBM production, groundwater levels within coal seam aquifers could be drawn down over large, contiguous areas of the state. For example, the Upper Tongue watershed covers 590,000 acres and could hold 5,800 CBM wells as projected in the RFD. Over the life of the project approximately 5 percent of the groundwater in the coal seam aquifers could be lost to CBM production in this watershed. Following methodology detailed in the *Water Resources Technical Report* (ALL 2001b), potential CBM-producing wells per watershed and potential coal seam aquifer groundwater production estimates for 20 years of production for each of the watersheds have been calculated and are listed in Table 4-26.

The nature of the Fort Union Formation coal seam aquifers that contain the methane gas (i.e., layers of coal interbedded with shale layers having low vertical hydraulic conductivity) should minimize effects to aquifers above and below these seams. Although production of CBM water enhances cleat within the coal seams, it would not propagate vertical fracturing into the adjacent shale confining units.

As more of the groundwater in methane-productive coal seams is depleted, more water wells and springs that deliver water from productive coal seam aquifers would be impacted and it would become more difficult to mitigate water well impacts by transporting water to residents. Depending on the distribution of the CBM development, coal seam aquifer drawdown could be concentrated in scattered producing areas. Mitigation agreements are expected to facilitate replacement of

TABLE 4-26
GROUNDWATER DEPLETION BY CBM DEVELOPMENT IN THE MONTANA POWDER RIVER BASIN

Watershed	Potential CBM Producing Wells	Potential Produced CBM Water in 20 years (billion cubic feet)
Little Big Horn	675	2.5
Little Powder	200	0.7
Lower Bighorn	800	2.8
Lower Tongue	3,450	12.0
Lower Yellowstone	1,700	6.0
Middle Powder	2,100	7.4
Mizpah	125	0.5
Rosebud	3,600	12.6
Upper Tongue	3,850	13.5
Total	**16,500**	**58.0**

Note: Calculated maximum potential coal seam aquifer groundwater production by watershed (billion cubic feet) after 20 years of CBM production. Details on the method used to calculate these numbers can be obtained from the *Water Resources Technical Report* (ALL 2001b).

water lost to the drawdown of groundwater levels within producing coal seam aquifers, but in areas of concentrated depletion water sources may not support water replacement. In such cases, either agriculture that depends upon groundwater, or CBM development would need to be limited.

Recovery of the coal seam aquifers after production ends is a slow process involving recharge from undrained areas of the aquifer, infiltration of precipitation from the surface in areas where the coal aquifers outcrop, and the slow process of infiltration from aquifers above and below the produced coal seams (this is expected to take the longest time because of the confined nature of these units).

Modelers that assisted the Wyoming BLM determined that coal seams that have experienced substantial drawdown also experience recovery as a two-part process:

> "After CBM development (and water removal) ends, within three to four years water levels in the coal aquifers are expected to partially recover to within 20 to 30 feet of pre-operational conditions. Complete water level recovery will be a long-term process, likely requiring hundreds of years for the removed groundwater to be replaced through the infiltration of precipitation." (BLM 2000b).

A similar recovery process is expected to occur in the Montana area of CBM interest with most of the recovery happening in a short time but full coal seam aquifer recovery requiring hundreds of years. The 3D computer modeling conducted in conjunction with the preparation of this EIS estimates recovery schedules for methane-productive coal seams, nonproductive coal seams, and surface aquifers in Montana. For productive coals within CBM fields, the aquifers are expected to recover at least 70 percent of their hydrostatic pressure within 5 to 12 years. Outside the field, productive coals should regain 90 percent of their pressure within 3 to 5 years. Nonproductive coals are predicted to regain 80 percent of their pressure within 5 years. Surface aquifers that are projected to lose only 6 feet of pressure, would regain 50 percent of that pressure in less than 10 years (Wheaton and Metesh 2002). Precise local groundwater recovery differs depending on site-specific conditions.

An estimated 2.9 bcf of produced water would be injected into deep aquifers annually throughout the state. This process would not affect coal seam aquifers. The injection of CBM-produced water has not been conducted in Montana, but is commonplace for waters produced from conventional oil and gas activities. In the year 2000, the state of Montana averaged 847 injection/disposal wells that disposed of 0.6 billion cubic feet of water every year (average injection of 128,000 bbl of water per well per year). Injection of

CBM water under this alternative is estimated to increase the number of injection wells to nearly 3,000. These new CBM injection wells would have an average injection rate of 265,000 barrels of water per well per year. This water would be injected into deep aquifers, whose water is not fit for use. Given the effectiveness of current injection regulations, the increase in injected volume resulting from CBM production is anticipated to have only a minimal effect on surface water or groundwater resources.

In those portions of Montana where CBM is developed outside of the Powder River Basin, CBM production is not expected to be as concentrated and hydrological impacts would be less. Limited CBM production in these areas would result in the localized drawdown of groundwater levels within coal seam aquifers. The extent of a 20 foot drawdown is estimated at less than 5 miles from the edge of production (Wheaton and Metesh 2001).

Abandonment

When the estimated 16,500 production wells are abandoned throughout the life of the resource in the planning area, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would mitigate the potential for impacts to surface water resources resulting from soil erosion until groundcover and original site conditions are restored. CBM wells that are not produced, or have reached the end of their productive life would be abandoned in accordance with existing regulations, and procedures for the abandonment of oil and gas wells to protect groundwater resources, or converted to monitoring wells, as deemed necessary.

Crow Reservation

Surface water effects on Crow Tribal Lands under Alternative B would include those impacts noted in Alternative A. Additional impacts from suspended sediment due to soil erosion and runoff from the disturbed acreage are expected near the Crow Reservation from the development of fee land within the exterior boundaries of the Crow Reservation, or from development of CBM on Tribal Lands.

Groundwater impacts would include those detailed in Alternative A as well as additional impacts from nearby wells. The Tribe can expect up to 20 feet of drawdown in coal seam aquifers from CBM wells within 4 to 5 miles of the Reservation boundaries towards the later part of the 20 year production period. The drawdown in producing coal seams may be as high as 10 feet for wells within 1 to 2 miles of the boundary during the early stages of production. This drawdown would affect water wells and springs within the reservation that derive water from productive coal seam aquifers.

In addition, because of the large presence of fee land within the exterior boundaries of the Crow Reservation, CBM development on those non-reservation lands could also affect surface water and groundwater in a manner consistent with other areas of the Powder River Basin. The development of CBM on fee lands within the reservation boundary could result in increased suspended sediment loads from surface disturbances in the Bighorn, Little Bighorn, Rosebud, and Squirrel Creek watersheds.

Northern Cheyenne

Surface water effects on Northern Cheyenne Tribal Lands under Alternative B would include those impacts noted in Alternative A. Additional effects are expected from suspended sediment as a result of soil erosion and runoff from the area upstream of the Northern Cheyenne Reservation. Increased sediment loads would affect both the Tongue River and Rosebud Creek watersheds resulting from the surface disturbances associated with CBM development. Groundwater drawdown effects on the reservation would be similar to impacts in other areas of the Powder River Basin. The Tribe can expect up to 20 feet of drawdown in the produced coal seam aquifers from wells 4 to 5 miles from the reservation boundary. This drawdown would affect water wells and springs within the reservation that derive water from the produced coal seam aquifers.

Conclusion

Impacts on surface water and groundwater as a result of Wyoming CBM development would be same as discussed under Alternative A. Impacts on surface water would include those impacts listed under Alternative A plus the impact of suspended sediment generated by soil erosion taking place near CBM development. There would be no substantial increase in surface water flow beyond what was described for Alternative A because all CBM produced water would be managed by deep injection.

CBM production in Montana under Alternative B would result in the withdrawal of approximately 5 percent of the groundwater resources contained within the producing coal seams and approximately 0.1 percent to 0.2 percent of the total recoverable groundwater resources that underlie Montana's portion of the Powder River Basin. This withdrawal estimate was derived from Specific Storage values ($3x10^{-4}$ to 9×10^{-4}) from modeling (Wheaton and Metesh, 2002) assuming an average of 70 feet of coal and a drawdown of 200 feet needed to release economic volumes of methane. Water wells near CBM fields could experience drops in static water levels in excess of 100 feet. Water well and spring mitigation agreements would facilitate replacement of groundwater lost to the drawdown of groundwater levels within these coal seam aquifers. Replacement of groundwater supplies may be difficult in some areas and may require supply from off-site sources.

Alternative C—Emphasize CBM Development

Alternative C consists of the direct discharge of CBM-produced waters to the land surface. Impacts to water resources resulting from this alternative would consist of coal seam drawdown-related effects similar to Alternative B, and effects due to the large volume of CBM water being discharged to the ground and allowed to flow into drainages and water bodies.

Discharge to the ground would cause increased soil erosion between the discharge point and the nearest drainage. There would be a corresponding increase in the suspended sediment load in surface waters adjacent to CBM development. As CBM water flows along drainages, infiltration of the water would occur, resulting in rising shallow groundwater elevations, and shifts in the chemistry of the shallow groundwater. These shifts in groundwater chemistry may improve or degrade the usability of the groundwater, depending on site-specific conditions. In the long term, this infiltration would result in diffuse discharge of CBM water into waterways as the CBM water flows downgradient in the alluvial aquifers until a perennial waterway is reached.

CBM water that does not infiltrate or evaporate en route would reach perennial waterways as point discharges. The addition of CBM water to drainages and surface water bodies, through both point and diffuse discharges, would result in increased flow volumes and changes in water chemistry. These changes would, in turn, lead to loss of soil structure, increased erosion rates, and increased suspended sediment loads. The chemistry of the surface waters would also potentially impact some uses by humans and wildlife.

Exploration

Impacts would be similar to those described in the Alternative B discussion. The moderate volume of water generated by the testing of CBM exploration wells would be stored in tanks or impoundments to be discharged under the appropriate permits.

Production

Alternative C assumes that 80 percent of the volume of CBM water produced would be discharged directly to the land surface adjacent to the wellhead. Impacts to water resources would consist of those effects of coal seam drawdown described in Alternative B, soil erosion and the increase in suspended sediments in area rivers and streams, changes in the elevation of groundwater in alluvial aquifers, changes in alluvial aquifer water chemistry, and changes in the chemistry of perennial water bodies. The discharge at the CBM wellhead would result in the erosion of soils, creating gullies that would connect to natural runoff areas where the water would join natural drainage. These natural drainages or ephemeral portions of the water-course would also be impacted by increased erosion and would likely become more nearly perennial as a result of receiving CBM discharge water. Before the CBM water reaches surface water, some portion would evaporate or infiltrate into the soil. The portion lost would depend upon season of the year, permeability of the soil, and the presence of a shallow, unconfined aquifer connected to surface water.

Produced water discharged to the surface would be released by one of the following routes: directly to surface water or drainages, into on-drainage impoundments, and into off-drainage impoundments. These three discharge routes would impact surface and groundwater in different ways:

- Water lost to infiltration or evaporation would depend upon the distance of transport to the surface water body, the amount of CBM water discharged, the physical characteristics of the drainage, and climatic conditions.
- Discharge to an impoundment constructed by damming an ephemeral drainage (on-drainage pond) would result in losses by evaporation and infiltration. The infiltration would lead to groundwater doming under the pond that could rise far enough to intersect the ephemeral stream, causing discharge to the stream during part or all of the year. Drainage impoundments would also prevent stormwater runoff from flowing down drainage and into perennial surface water bodies.

- Discharge to an impoundment constructed near the ridge-line separating drainages (off-drainage pond) would also result in losses by evaporation and infiltration, but the infiltration and groundwater doming associated with infiltration would have less tendency to intersect ephemeral drainages.

Saline seeps may form below both off-drainage and on-drainage discharge reservoirs as salt-laden waters seep out intersect a confining layer, and flow to the outcrop. All surficial discharges must comply with an MPDES permit. A copy of the Montana general discharge permit for coal bed methane produced water is attached at the end of the Hydrology Appendix. The MPDES fact sheet can be obtained from the MDEQ.

Losses associated with evaporation would reduce water volume, but not reduce salt load, and would increase the salinity of the water remaining in the impoundment. How much evaporation takes place would depend upon residence time in the pond and climatic conditions of humidity, temperature, wind, and rainfall. Increased salinity in the stored water would act upon the pond's soil liner by causing dispersal of the clay particles in the soil. Increased salinity would tend to reduce the pond's permeability, reduce subsequent infiltration, and increase residence time in the pond.

It is likely that water that infiltrates into shallow, unconfined alluvial aquifers would be delayed in reaching surface water but not be completely lost to the system. A Portion of the projected conveyance loss would enter shallow groundwater flow systems and eventually reach streams and rivers.

Surface waters could be impacted by infiltrated water that contacts shallow groundwater sources and eventually discharges into surface water bodies. Infiltrated water that was stored in an impoundment would have elevated concentrations of some constituents as a result of evaporation. As this water infiltrates through the soil and bedrock, changes to its quality would occur from interactions with the soil, rock, and connate water. The impacts from this water would be difficult to quantify as the distance and residence time within shallow aquitards and shallow aquifers affect the quality of the water that might subsequently be discharged into the surface waters.

Produced water would also be placed into impoundments for use by livestock and wildlife. Water placed in impoundments can be lost to evaporation and seepage/infiltration into the soil below the impoundment. Impoundments are usually constructed of native soil present on site, however, local soils vary widely in their permeabilities as described in the *Soils Technical Report* (ALL 2001a). Impoundments constructed of sandy soils would allow more infiltration of produced water than those built from clay. Water stored in sandy impoundments would be more liable to seep into deeper soil horizons where the water could increase the salinity of the soils. Produced water would also be able to seep into unconfined aquifers if these were present, modifying the quality of the native groundwater. The specific soil types and impoundment locations are unknown with regards to future CBM developments in Montana. The degree of produced water infiltration cannot be estimated without site-specific data. A copy of the Montana general discharge permit for coal bed methane produced water that is discharged to holding pounds is attached at the end of the Hydrology Appendix. The MPDES fact sheet of this general permit can be obtained from the MDEQ.

Impacts on groundwater under this alternative would be the same as in Alternative B, except that discharged water could infiltrate into soils and underlying shallow alluvial aquifers. The produced water from the only Montana CBM field (CX Ranch) has an SAR value in excess of the water contained in most shallow aquifers, including the alluvial aquifers (ALL 2001b). If infiltration of CBM-produced water occurred, the water quality of the alluvium could be adversely impacted.

Surface Water Analysis

Surface waters that could be affected by developments connected with this alternative include the watersheds connected with the Tongue, Powder, Little Powder, Little Bighorn, Bighorn, and Yellowstone Rivers. In addition, other watersheds in nearby counties, including the counties of Gallatin, Stillwater, and Blaine, may be affected by statewide development of CBM resources. The following discussion concentrates on watersheds of the Powder River Basin, because the Powder River Basin is the most likely area for major CBM activity that could impact surface water resources. Reference is made to the water quality limits proposed by various interest groups within the Powder River Basin, including the MDEQ, the Northern Cheyenne Tribe, and other Petitioners. With the exception of the Northern Cheyenne Tribe's standards that have been approved by the Tribe and are awaiting the EPA's approval, these standards are proposed ranges, which may or may not be the limits that are accepted by the State of Montana. Modeling results are also compared to scientifically accepted criteria, particularly the Ayers and Westcott (1985) EC versus

TABLE 4-27
EFFECTS ON SURFACE WATERS OF THE TONGUE RIVER UNDER ALTERNATIVE C

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative C		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Tongue River at Stateline near Decker	0.5	500	10	2500	178	0.86	731	187	2.68-2.94	806-812
Tongue River Near Birney Day School	0.5	500	10	2500	183	1.09	863	213	6.38-7.43	1055-1080
Tongue River at Brandenburg Bridge near Ashland, Montana	0.5	500	10	2500	207	1.36	1016	265	9.51-11.22	1278-1319

SAR relationship of impacts to the infiltration capacity of irrigated soils.

Tongue River

The Tongue River could be impacted from current and future CBM development in both the Wyoming and Montana portions of the Powder River Basin. The detailed input data, calculation of effects, and a summary of impacts are presented in the SWQATR.

Table 4-27 encapsulates the effects for three stream stations along the Tongue River in Montana for Alternative C.

These results show the combined effects for CBM water discharged from RFD development for Wyoming and Montana. These discharges would result in a 10 to 27 percent increase in surface water EC, a 211 to 725 percent increase in surface water SAR, and a 5 to 28 percent increase in flow. The resultant mixed stream water can be compared to the following surface water criteria:

- MRPLs: These limits are set at 0.5 SAR and 500 µS/cm EC for the Tongue River. As such, the Tongue River's existing stream water quality is above these SAR and EC limits, and it would not be able to receive additional CBM discharge if these limits were adopted. The forecasted impacts from Wyoming and Montana CBM water under Alternative C, are even further in excess of these limits.
- LRPLs: These limits are set at 10 SAR and 3000 µS/cm EC for the Tongue River. The resultant mixed water quality during Minimum Mean Monthly flow would only exceed these limits at the Ashland station under Alternative C. All other monthly average mixed waters would be below these limits; the 7Q10 flow would be in excess of the SAR limit.
- Northern Cheyenne Proposed Standards: The resultant mixed water quality at the stateline station would exceed the proposed irrigation season limits for SAR during 5 months out of the year and the 7Q10; the 7Q10 flow would also exceed the EC limit. The resultant water quality is similarly above the non-irrigation season proposed limits.

  The resultant water quality at the Birney Day School station, near the southern boundary of the Reservation, would exceed the SAR limit for 11 months of the year and would only exceed the EC limit during 7Q10 flows. The water quality near the northern end of the Reservation is seen at the Ashland station. The calculated impacts at Ashland demonstrate that the Northern Cheyenne proposed standards would be exceeded for SAR on all but one month while the EC limits would not be exceeded.
- Ayers and Westcot (1985) water quality plot: Impact analyses show that Tongue River water at Decker would not result in impacts to soil except during 7Q10 flow. The resultant water quality at the Birney Day School and Ashland stations would result in some impacts to soil during irrigation use. Texture and permeability, especially of clayey soils, could be reduced if the mixed Tongue River water from Birney Day

TABLE 4-28
EFFECTS ON SURFACE WATERS IN THE POWDER RIVER UNDER ALTERNATIVE C

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative C		
Station	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Powder River at Moorhead	2	1000	10	3200	145	4.65	2154	231	11.08-11.56	2226-2253
Powder River at Locate	2	1000	10	3200	143	4.61	2287	250	11.97-13.13	2323-2361

School and Ashland were to be used for irrigation. Irrigators would need to alter their management schemes to avoid these impacts under Alternative C. Plots showing these effects are included in the SWQATR.

The surface water quality of the Tongue River would be reduced, requiring management practice changes by downstream users during part or all of the year under Alternative C. Although this is a legal option, so long as a CBM producer were granted a permit to degrade surface waters by the MDEQ, such an action would be contrary to the current policy of MDEQ, and the US EPA.

Powder River

The Powder River has its headwaters in the Wyoming portion of the Powder River Basin and as such would receive CBM water from development in Wyoming and Montana. The detailed analysis and calculations for the data summarized in Table 4-28 can be found in the SWQATR. Table 4-28 summarizes the impacts for two stations along the Powder River for Alternative C during the minimum mean monthly flow. The analysis conducted at the Locate station includes all CBM discharge in the Powder, Little Powder, and Mizpah watersheds, cumulatively.

The Powder River contains water that is naturally above some of the proposed limits. The Powder River is expected to be affected by Wyoming and Montana CBM development under this alternative. The resultant water quality is altered by slight changes of 1 percent to 3 percent for EC, but SAR increases by as much as 200 percent. The flow rate is expected to increase between 25 percent and 30 percent. The resultant mixed stream water and CBM water can be compared to the following surface water criteria:

- MRPLs: These limits are set at 2.0 SAR and 1000 μS/cm EC for the Powder River. As such, the Powder River's existing stream water quality is above the SAR and EC limit and it would not be able to receive additional CBM discharge if these limits were adopted. The forecasted effects from Wyoming and Montana CBM water are even further in excess of these limits.
- LRPLs: These limits are set at 10 SAR and 3,200 μS/cm EC. The resultant mixed water quality during Minimum Mean Monthly flows and 7Q10 flows would exceed the SAR limit at the Locate station. All other Locate station mixed waters would be below these limits. The Moorhead station's mixed water quality would exceed the proposed SAR limit for half of the months analyzed, and for the 7Q10 flow. The proposed EC limits would only be exceeded at the Moorhead station during 7Q10 flow.
- Ayers and Westcot (1985) water quality plot: The SWQATR displays the SAR vs EC plots that show that the only time the water quality at the Powder River stations would be likely to cause infiltration impacts to soils under irrigation is during 7Q10 flow.

The surface water quality in the Powder River is reduced under Alternative C. These effects would likely require management practice changes by downstream irrigators. Although this is a legal option, so long as a CBM producer were granted a permit to degrade surface waters by the MDEQ, such an action would be contrary to the current policy of MDEQ, and the US EPA.

TABLE 4-29
EFFECTS ON SURFACE WATERS IN THE MIZPAH CREEK UNDER ALTERNATIVE C

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality (Min Mean Monthly) Under Alternative C		
Station	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Mizpah Creek at Mizpah	2	1000	10	3200	0.26	16.6	3503	0.99	20.43-35.26	2663-3163

Little Powder River

The effects to the Little Powder River station at Weston, Wyoming, would be the same as Alternative A since there are no Montana wells being discharged upstream of this station. The impacts from Montana wells downstream of this station are analyzed in the analysis for the Powder River at Locate station.

Mizpah Creek

Mizpah Creek carries water into the Powder River in Montana. There are no CBM wells in Wyoming that could effect this watershed. Under Alternative C effects to Mizpah Creek would result from the discharge of Montana CBM produced water only. Table 4-29 summarizes predicted changes in surface water chemistry in Mizpah Creek just upstream from its junction with the Powder River.

Mizpah Creek contains water that naturally exceeds the LRPLs. Although CBM discharge would decrease surface water EC by 10 to 24 percent, the SAR would increase by 25 to 112 percent. The resultant mixed stream water can be compared to the available surface water criteria:

- MRPLs: These limits are set at 2.0 SAR and 1,000 μS/cm EC and, as such, Mizpah Creek's existing stream water quality is well above the SAR and EC limits. The mixed water EC would decrease but SAR would increase. This would cause these waters to further exceed the SAR standard and so no discharge could occur in this creek if these standards were adopted.
- LRPLs: These limits are set at 10 SAR and 3,200 μS/cm EC. As such, Mizpah Creek's existing stream water quality is above the SAR and EC limits. The mixed water EC would decrease but SAR would increase. This would cause these waters to further exceed the SAR standard and so no discharge could occur in this creek if these standards were adopted.
- Ayers and Westcot (1985) water quality plot: The SWQATR displays the plots that show the mixed water quality at the Mizpah station would likely cause infiltration impacts to soils under irrigation during all flows except for one or two high flow months a year. Discharge of CBM waters would cause further exceedance of these criteria.

The surface water quality of Mizpah Creek would be reduced under Alternative C, however, as these waters are currently in excess of all criteria considered, this would not result in an impact to beneficial use.

Bighorn and Little Bighorn Rivers

These rivers carry water from the Bighorn Mountains north from Wyoming into Montana. No CBM wells in Wyoming are expected to affect these rivers. Under Alternative C, the effects to these Rivers would be the result of discharge from Montana CBM discharge only. Table 4-30 summarizes the effects for two stations along the Little Bighorn River and one on the Bighorn River, just upstream from its confluence with the Yellowstone River, for the minimum mean monthly flow.

The resultant water quality impacts for these rivers would include an increase in EC by approximately 11 percent to 162 percent and an SAR increase of 27 percent to 400 percent. Flows would increase by 2 to 8 percent. The resultant mixed stream water can be compared to the following surface water criteria:

- MRPLs: These limits are set at 0.5 SAR and 500 μS/cm EC. The existing stream water quality in these rivers is above the SAR and EC limits during several months at several stations and would not be able to receive additional CBM discharge if these limits were adopted. The forecasted effects from Montana CBM

TABLE 4-30
EFFECTS ON SURFACE WATERS OF THE BIGHORN AND LITTLE BIGHORN RIVERS UNDER ALTERNATIVE C

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative C		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Little Bighorn River at Wyola	0.5	500	10	2500	110	0.53	548	115	2.26-2.64	623-632
Little Bighorn River at Hardin	0.5	500	10	2500	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	0.5	500	10	2500	1523	2.08	952	1542	2.54-2.64	968-970

development under Alternative C are even further in excess of these limits.

- LRPLs: These limits are set at 10 SAR and 2,500 µS/cm EC. As such, the Hardin station's existing stream water quality during 7Q10 is above the SAR limit. For the rest of the stations and flows, the mixed water quality parameters would be well below these limits.
- Ayers and Westcot (1985) water quality plot: The Technical Report displays the plots that show the mixed water quality at the Wyola and Hardin stations would be likely to cause infiltration impacts to soils under irrigation during several months of the year. The resultant water qualities represent a low EC to SAR relationship and thus the water would likely impact clayey soils if used for irrigation. Water quality at Bighorn would likely cause no infiltration impacts and be adequate to use for irrigation.

The surface water quality in the Bighorn Rivers in Montana is slightly reduced, resulting in minor management practice changes by downstream users for continued irrigation use. Although this is a legal option, so long as a CBM producer were granted a permit to degrade surface waters by the MDEQ, such an action would be contrary to the current policy of MDEQ, and the US EPA.

Rosebud Creek

Rosebud Creek drains part of the area of the Powder River Basin in Montana. This creek begins on the Crow Reservation, flows through a portion of Montana, flows through the Northern Cheyenne Reservation, then through another portion of Montana prior to joining the Yellowstone River near Rosebud Montana. No CBM wells in Wyoming could affect the Rosebud. The effects to this stream would be the result of CBM discharges in Montana. Table 4-31 summarizes the predicted effects for two stations along Rosebud Creek in Montana for the minimum mean monthly flow.

These results show the effects of CBM discharge on the flow and water quality of Rosebud Creek. Because there is so little water in the Creek naturally, flow increases by an order of magnitude with CBM discharge and water quality is more representative of the CBM discharged water than the existing stream water quality. The resultant mixed stream water and CBM water can be compared to the available surface water criteria:

- MRPLs: These limits are set at 1.0 SAR and 500 µS/cm EC. As such, Rosebud Creek's existing stream water quality is above the SAR and EC limit and would not be able to receive additional CBM discharge if these limits were adopted. The forecasted effects from Montana CBM water under Alternative C are far in excess of the MRPL.
- LRPLs: These limits are set at 10 SAR and 2,500 µS/cm EC. Both the stations' mixed stream water qualities are well above the SAR limit but below the EC limit.

TABLE 4-31
EFFECTS ON SURFACE WATER OF ROSEBUD CREEK UNDER ALTERNATIVE C

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative C		
Station	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Rosebud Creek at Kirby	1.0	500	10	2500	1.78	0.77	1016	22	35.62-43.25	2110-2293
Rosebud Creek at Rosebud	1.0	500	10	2500	8.42	4.84	1780	49	32.85-39.32	2133-2298

- Ayers and Westcot (1985) water quality plot: The plots show that the mixed water quality at the Kirby and Rosebud stations would likely cause severe infiltration impacts to soils under irrigation during all months of the year under Alternative C.

Under Alternative C, the surface water quality in Rosebud Creek in Montana is reduced, resulting in severe curtailment of irrigation use of this water. Although this is a legal option, so long as a CBM producer were granted a permit to degrade surface waters by the MDEQ, such an action would be contrary to the current policy of MDEQ, and the US EPA.

Lower Yellowstone River

The waters of the Yellowstone River are the confluence of all the other watersheds that are expected to receive effects from CBM development in Montana. The Forsyth station would be affected by CBM discharges into the Bighorn and Little Bighorn watersheds. The Sidney station would be affected by all Montana CBM development, and that development in Wyoming that occurs in the Tongue, Powder, and Little Powder watersheds. Table 4-32 summarizes the impacts for two stations along the Yellowstone River in Montana for the minimum mean monthly flow for Alternative C.

Because of the significant volume of water available in the Yellowstone to dilute the CBM production water in Montana and Wyoming, the resultant water quality shows only slight changes in both EC and SAR. The resultant mixed stream water and CBM water can be compared to the following surface water criteria:

- MRPLs: These limits are set at 0.5 SAR and 500 μS/cm EC. The Yellowstone River's existing stream water quality is above the SAR and EC limit for all months out of the year and would not be able to receive additional CBM discharge during these times if these limits were adopted. The forecasted impacts from Wyoming and Montana CBM water under Alternative C are also exceeded by these limits.
- LRPLs: These limits are set at 10 SAR and 2,500 μS/cm EC. As such, the mixed stream water qualities are well below these limits.
- Ayers and Westcot (1985) water quality plot: The plots show that the mixed water quality would not cause infiltration impacts to soils under irrigation at any time. Under Alternative C, the surface water quality in the Yellowstone River in Montana is slightly reduced; however, there should be no management practice changes required of downstream users for continued irrigation use of this water. The resultant water quality in the Yellowstone River is sufficient for irrigation even during the months with the lowest flows.

Abandonment

Effects on water resources caused by abandonment operations would be similar to impacts by produced water discharged to the surface. The two activities—soil disturbance at abandonment and 20 years of surface discharge—would combine to increase the suspended sediment load within area surface water streams and rivers.

Crow Reservation

Effects on the Crow Reservations' surface water would be in the form of increased flow volume and changes in water quality. Groundwater impacts would be the same as Alternative B. In addition, potential CBM development on fee land within the external

TABLE 4-32
EFFECTS ON SURFACE WATERS OF THE YELLOWSTONE RIVER UNDER ALTERNATIVE C

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative C		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Lower Yellowstone-Sunday near Forsyth	0.5	500	10	2500	5820	1.99	745	5850	2.18-2.22	753-754
Lower Yellowstone-Sunday near Sidney	0.5	500	10	2500	5764	2.00	870	5945	3.12-3.31	912-917

boundaries of the reservation could cause more direct effects that would also be similar to those effects described for the CBM emphasis area. Surface waters would be affected in terms of both quantity and quality based on the extent of discharge to the watersheds within the reservations boundary (Bighorn, Little Bighorn, Rosebud, and Squirrel Creek watersheds). The effects on these surface waters would place additional impacts onto the Tribe's way of life by limiting the uses of effected waters.

Northern Cheyenne

Effects on the Northern Cheyenne Reservation are similar to effects projected for the CBM emphasis area. Effects to surface water would include increases in flow volume and changes in various water quality parameters in the Tongue River and Rosebud Creek watersheds. The effects to the Tongue River and Rosebud Creek watersheds from Wyoming and Montana CBM development could affect existing uses of these waters within the reservation boundary. Groundwater effects would be the similar to Alternative B, with additional impacts resulting from the infiltration of produced water into shallow aquifers along the Tongue River and Rosebud Creek watersheds within the reservation boundary.

The effects to these surface waters would limit the uses of affected waters. The changes to groundwater quality that result from infiltration would be site-specific and depend on the quality of the alluvial aquifers. The Tribe can expect drawdown of coal seam aquifers from CBM production in the area surrounding the reservation for distances of approximately 4 to 5 miles.

Conclusion

Effects on groundwater include those listed under Alternative B, as well as effects from infiltration of surface water into shallow aquifers from impoundments and drainages.

Surface water quality in some watersheds would be slightly to severely degraded, resulting in restricted downstream use of some waters. Surface water flows will be considerably increased in some watersheds, causing persistent riparian erosion, changes in watercourses, and increased sedimentation. The LRPLs would be exceeded in the Tongue and Powder River and Mizpah and Rosebud Creek watersheds under the minimum monthly flows. However, there are other months where discharges would be allowed in all of these watersheds where the resultant water quality would not exceed the LRPL or other relevant limits.

The Bighorn, Little Bighorn, and Lower Yellowstone rivers' resultant water quality would be below the LRPLs, even during the minimum monthly flows.

Area surface waters would be affected by an increase in suspended sediments contained in the discharged CBM water. This increase in suspended sediment load would result from the increased erosion of soils due to surficial disturbances, CBM water runoff from the point of discharge to drainages, and from the increased erosion of stream banks resulting from increased water volume and increased SAR (which causes clays to lose their cohesiveness and erode more easily). The increase in suspended sediment content of surface water could affect its beneficial uses. All of the watersheds in the CBM emphasis area would be vulnerable to effects from an increase in suspended sediment. Discharge to ephemeral channels would cause deepening and widening of the channels.

TABLE 4-33
SUMMARY OF SURFACE WATER PARAMETERS BEFORE AND AFTER MIXING[1] UNTREATED CBM DISCHARGE FROM WYOMING AND TREATED CBM DISCHARGES FROM MONTANA UNDER ALTERNATIVE D

	Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity Under Alternative D (Min Mean Monthly)		
Station	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Tongue River Stateline Near Decker	178	0.86	731	187	1.49	747
Tongue River Near Birney Day School	183	1.09	863	213	1.59	824
Tongue River at Brandenburg Bridge Near Ashland, Montana	207	1.36	1016	265	1.67	904
Little Bighorn River at Wyola	110	0.53	548	115	0.53	548
Little Bighorn River at Hardin	123	0.99	768	133	0.99	768
Bighorn River at Bighorn	1523	2.08	952	1542	2.08	952
Rosebud Creek at Kirby	1.78	0.77	1016	22	0.77	1016
Rosebud Creek at Rosebud	8.42	4.84	1780	48	4.84	17804
Little Powder River Stateline Station Weston, WY (No Montana CBM wells will impact this station)	2.6	6.94	3300	16	10.41	1606
Powder River at Moorhead	145	4.65	2154	231	11.08	2226
Powder River at Locate	143	4.61	2287	250	10.89	2268
Mizpah Creek at Mizpah	0.26	16.6	3503	1.26	16.6	3503
Yellowstone at Forsyth, Montana	5820	1.99	745	5831	1.99	745
Yellowstone at Sidney, Montana	5764	2	870	5805	2.23	8703

[1] Calculations of flow volume and water quality were conducted for low mean monthly stream flows, and the maximum calculated levels of CBM discharge (year 6 discharge).

Alternative D— Encourage Exploration and Development While Maintaining Existing Land Uses

An estimated 20 percent of produced water would be used for beneficial uses, and the remaining 80 percent would be treated to pre-development surface water chemistry prior to discharge under a MPDES permit.

Discharge would be accomplished by pipeline or constructed watercourse to the nearest body of water to eliminate soil erosion, the generation of suspended sediments, and the infiltration of treated CBM water. The treatment of CBM-produced waters would eliminate or greatly reduce effects to surface waters. Treatment may increase the potential for beneficial uses of CBM water.

The changes in surface water quality shown in Table 4-33 for Alternative D are due to the discharge of untreated CBM water from Wyoming CBM development. Changes in flow volume are due to treated and untreated discharges in both Montana and Wyoming. The effects originating from Wyoming would be the same as those detailed under Alternative A. Effects on surface water from Montana CBM development are due to the increases in baseflow. The stations analyzed would experience a 0.2 percent (Yellowstone at Forsyth) to 1135 percent (Rosebud at Kirby) increase in flow under this alternative. These increases in water flow rates would be likely to cause changes in streambed geometry, flow regime, stream depth distribution, presence and condition of instream vegetation, and other physical factors associated with the stream and adjacent riparian zone.

Exploration

Any water generated by drilling and testing would be treated, with 80 percent of the treated water discharged via pipeline under a MPDES permit and 20 percent used for beneficial purposes. Treatment would eliminate potential impacts to water quality. Water quantity impacts would be minor because of the moderate volume produced from the testing of CBM exploration wells.

Production

Approximately 80 percent of CBM-produced water would be treated and discharged under this alternative. Because the water is piped to the receiving body of water, no conveyance losses are deducted.

Peak total field discharge during year 6 would add about 0.7 percent to the total water discharged to the Yellowstone. In detail, every watershed, except the Yellowstone, and the Bighorn, experience at least a 10 percent increase in flow in at least one portion of the watershed. Rosebud Creek, the Little Powder, and Mizpah Creek would experience the greatest percentage change in baseflow during year 6, with 1,135 percent, 515 percent, and 285 percent increases in baseflow respectively. These increases in flow volume would result in increased erosion in affected watersheds. Since discharge water would be treated, the water quality of the streams, and therefore the beneficial uses of surface waters, would not be effected

The treatment of CBM-produced waters could result in the generation of residues that would contain concentrated salts extracted from the CBM water. This residum would need to be analyzed on a case-by-case basis to determine its character and would need to be disposed of in an appropriate manner.

Effects on groundwater from CBM production under Alternative D would be similar to those described for Alternative B.

Abandonment

Effects on water resources caused by abandonment operations would be similar to the effects identified under Alternative B. When the estimated 16,500 CBM production wells are abandoned over the 20-year life of the resource, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material would be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would control soil erosion until groundcover and original site conditions are restored.

Crow Reservation Impacts

Surface water impacts on Crow Tribal Lands under Alternative D are expected to include those impacts noted in Alternative B. Because the produced water would be treated prior to discharge, the reservation could expect impacts to surface water in the form of increased flow volume to the Bighorn, Little Bighorn, Rosebud, and Squirrel Creek watersheds from development on fee lands within the external boundary of the reservation. Groundwater effects would be similar to those detailed in Alternative B.

Northern Cheyenne Impacts

Surface water impacts on Northern Cheyenne Tribal Lands under Alternative D are expected to include those effects noted in Alternative B with the added effects from the surface discharge of 80 percent of the produced water from all of the Montana CBM wells forecast in the RFD in the Rosebud and Tongue River watersheds. Groundwater effects would include those detailed in Alternative B.

Conclusion

Treatment and discharge of produced water from Montana would not affect surface water quality, but would affect river flow volumes. Flow volumes in some watersheds would change only slightly, but some watersheds would see large flow increases, especially during times of traditionally low flow. The effects of these changes could include bank erosion, riparian area alteration, and loss of indigenous habitat. Effects to surface water flow would be similar to but slightly greater than for Alternative C, due to lower conveyance loss. Effects on Montana watersheds at the state line stations from Wyoming CBM discharge would be the same under this alternative as under Alternative A. The discharge of treated CBM water would dilute Wyoming CBM discharges as these waters flow further into Montana. Cumulative effects on surface water could include localized erosion and stream alteration. These effects would be similar to those caused by major rain events, but would be concentrated into small producing areas rather than spread over the entire watershed and last for the duration of the producing fields life.

Effects from surface impoundments would be similar to effects under Alternative C, except that produced water would be treated prior to storage, reducing the chances that the salinity of sub-soils and shallow, unconfined aquifers would be increased.

Drawdown effects to groundwater would be the same as under Alternative B.

Alternative E—Preferred Alternative

Water produced from CBM wells could be managed in a much broader fashion than has been analyzed in the previous alternatives by emphasizing beneficial use of CBM water and that MPDES requirements be met. A Water Management Plan (WMP) would be required prior to exploration or production. Water management options would include injection, treatment and discharge, impoundment, direct discharge, or any other operator proposed methods, provided that they are addressed in the WMP, the plan is approved by the appropriate agency, and MPDES requirements are met. The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability, and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with Plans of Development (PODs), and would need to be approved prior to or concurrent with the approval of any Applications for permit to Drill (APDs).

Exploration

The volume of water generated by the testing of CBM exploration wells would be stored in tanks or lined (clay or geotextile) impoundments to be disposed of under the appropriate permits.

Production

Water would be produced by each of the 16,500 CBM wells expected to be developed in the CBM emphasis area. The maximum volume of CBM water would be produced during year 6 with lesser volumes before and after this period. Unlike Alternative C, the Preferred Alternative allows for wide latitude in produced water management. The combination of emphasizing beneficial use and increased flexibility for managing produced water would likely increase water used for beneficial purposes, such as stock watering, irrigation, dust control, etc. Increases in beneficial use would also result in decreased impacts resulting from surface discharge as compared to Alternative C. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), Alternative E assumes that 20% will be used beneficially.

Surface Water Analysis

The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBM development, the Powder River Basin is the area most likely to experience CBM activity. The Preferred Alternative management options would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin. It is assumed that surface discharge from Wyoming and Montana CBM would occur in each watershed until the resultant mixed water reaches the limits proposed for Montana streams. The remaining CBM water would be managed by other options including injection, treatment, infiltration or evaporation ponds, and beneficial use. The impact analyses calculate the expected effects on each watershed from the discharged CBM water, the amount of which varies from watershed to watershed. The final decision by the Montana Environmental Review Board may result in more or less stringent standards, in which case the amount of discharged CBM water would be altered so that surface water standards are met.

Tongue River

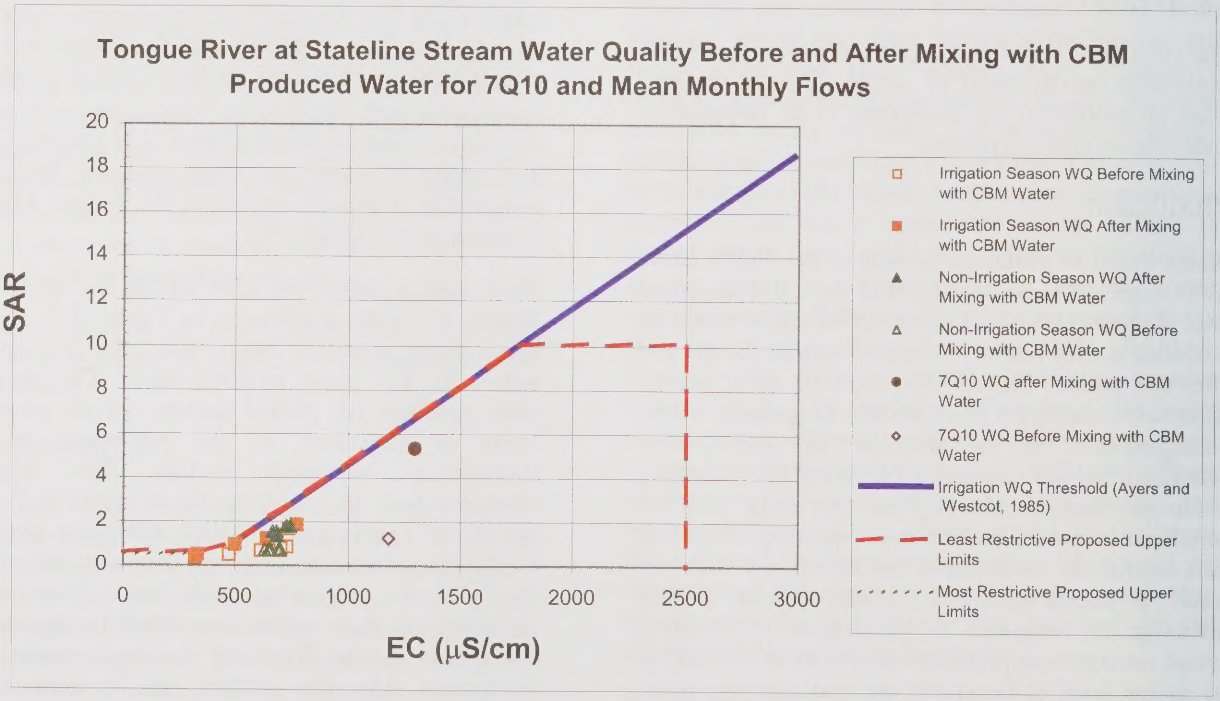
The Tongue River could be impacted by current and future CBM development in both the Wyoming and Montana portions of the Powder River Basin. As has been mentioned under previous alternatives, a detailed analysis for each station is provided in the SWQATR. The impact analysis discussed below is a summary of that analysis, using low mean monthly flows for comparison. This information for the Tongue River is summarized in Table 4-34.

Water quality before and after mixing for the Decker Station is shown graphically in Figure 4-2. In this figure water qualities before and after mixing are shown for low mean monthly flows. The resulting water qualities are plotted against several proposed limits as described at the beginning of the Hydrological Resources section. This diagram illustrates how the analysis for Alternative E was conducted. The volume of CBM water that could be discharged in Montana upstream from any station was calculated by beginning with the surface water chemistry and flow volume that would be expected at this station due to Wyoming discharges under their Alternative 2A. The volume of Montana CBM discharge assumed was then determined by increasing the volume until the LRPL was reached. The LRPL was chosen for this analysis as it represents the most severe impacts to surface water that can be reasonably

TABLE 4-34
EFFECTS ON SURFACE WATER FORECAST TO THE TONGUE RIVER UNDER THE PREFERRED ALTERNATIVE E

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative E		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Tongue River at Stateline Near Decker	0.5	500	10	2500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	0.5	500	10	2500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Montana	0.5	500	10	2500	207	1.36	1016	214	2.5	1058

FIGURE 4-2
WATER QUALITY PLOT BEFORE AND AFTER MIXING WITH WYOMING'S ALTERNATIVE 2A AND MONTANA'S ALTERNATIVE E CBM DISCHARGES TONGUE RIVER NEAR DECKER, MONTANA



expected given the data currently available. This should in no way be interpreted as an endorsement of this, or any, proposed standard by either the lead or cooperating agencies. The relationship between the resulting mixed waters with the proposed limits are discussed below:

- MRPLs: These limits are set at a SAR of 0.5 and an EC of 500 µS/cm for the Tongue River. Since the Tongue River naturally exceeds these limits for all but 2 months out of the average year, it cannot receive any CBM discharge if these limits are adopted. The forecasted impacts under Alternative E would be in excess of the these proposed limits.
- LRPLs: These proposed limits would be set at SAR of 10 and an EC of 2,500 µS/cm. These limits would not be exceeded during either the Minimum Mean Monthly or the 7Q10 flows under Alternative E.
- Northern Cheyenne Proposed Standards: Set at a SAR of 2.0 and an EC of 1,000 and 2,000 µS/cm at the south boundary of the Reservation. Surface water alteration forecasted under Alternative E would be below the Tribe's proposed limits except during 7Q10 flow.
- Ayers and Westcot 1985 water quality plot: The SWQATR discusses SAR versus EC plots as a way of determining potential impacts to soil texture after irrigation. The plot as shown in Figure 4-2 includes the boundary below which no impacts to soil are likely. Predicted water qualities during low mean monthly flows indicate that mixed waters will not cause infiltration impacts to soils under irrigation under Alternative E

The Tongue River is an important source of irrigation water in the Powder River Basin. The effects on the Tongue River would be the same as those for Alternative A, since no Montana CBM discharge to the Tongue would be assumed under this alternative analysis, besides discharge in accordance with the existing CX Ranch MPDES permit. This permit allows for 1,600 gpm of CBM discharge from up to 11 locations. Therefore, of the 33,282 gpm predicted to be produced during year 6 of the RFD, approximately 31,682 gpm will need to be managed by means other than surface discharge. This low level of surface discharge will not impact the beneficial uses of these surface waters.

As the impacts to other resources are dependent on the methods used to manage CBM produced water several additional assumptions needed to be made in order to conduct a meaningful analysis of Alternative E. As mentioned previously it is assumed that 20% of all produced water would be used for beneficial uses. For the Tongue River watershed this would be equal to 3,736 gpm being used for beneficial uses. It is then assumed that where it is physically possible to do so produced water will be managed via infiltration basins and injection wells. In this way the assimilative capacity of surface waters would be preserved for sites where it would not be possible to manage water through these methods. Since the geology necessary to conduct infiltration and injection operations will not be available at all sites it is assumed that 30% of all produced water will be managed through infiltration basins and 20% of all produced water will be managed by shallow injection. Within the Tongue River basin this would be equal to 5,604 gpm being managed through infiltration basins, and 3,736 gpm being managed through shallow injection. Next it is assumed that at sites where infiltration and injection are not possible the produced water would be discharged to surface waters to the degree allowed by the permitting process. For the Tongue River watershed this is equal to the 1,600 gpm currently allowed by the existing CX Ranch MPDES permit. Finally it is assumed that in cases where infiltration and injection are not possible, and discharge to surface waters can not be allowed, the remaining produced water will be managed equally by water treatment (such as reverse osmosis) and lined evaporation basins. For the Tongue River watershed this would be 2,002 gpm being managed by each of these means. A summary of these water management practices is presented in Table 4-35. This same distribution of water management practices is assumed for all watersheds analyzed. It should be noted that this distribution of water management practices is intended only for use in this analysis and is not intended to prescribe water management practices for any particular project. A site specific Water Management Plan will need to be developed for each project under Alternative E, and may include any, all, or none of the water management methods listed above.

As shown in Table 4-36, approximately 14,007 acres of surface disturbance are anticipated in the short term to accommodate produced water management in the Tongue River watershed. A total of 11,189 acres are estimated for long-term disturbance resulting from produced water management. The area of the Tongue River watershed is approximately 1.96 million acres (ALL, 2001b), this represents a short-term disturbance of 0.4 percent of the watershed, and a 0.3 percent long-term disturbance.

TABLE 4-35
WATER MANAGEMENT FRAMEWORK FOR THE TONGUE RIVER WATERSHED UNDER THE PREFERRED ALTERNATIVE E

Method	Volume to be Managed (gpm)	Rate Managed Per Site (gpm)	Number of Sites Needed	Acres Disturbed Short Term Per Site	Acres Disturbed Long Term Per Site	Cumulative Short Term Impacts	Cumulative Long Term Impacts
Beneficial Use	6,656	--	--	--	--	--	--
Infiltration Basins	9,984	9	1,142	6	5	6,852	5,710
Shallow Injection Wells	6,656	21	314	3	1	942	314
Surface Discharge	1600	150	11	0.01	0.002	1	1
Water Treatment	4,192	900	5	15	10	75	50
Evaporation Basins	4,192	4	1,023	6	5	6,138	5,115
Total	**33,282**					**14,008**	**11,190**

TABLE 4-36
EFFECTS ON SURFACE WATERS OF THE LITTLE BIGHORN AND BIGHORN RIVERS UNDER THE PREFERRED ALTERNATIVE E

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative E		
Station	SAR	EC (μS/cm)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)	Flow (cfs)	SAR	EC (μS/cm)
Little Bighorn River at Wyola	0.5	500	10	2500	110	0.53	548	115	2.26 – 2.64	623-632
Little Bighorn River at Hardin	0.5	500	10	2500	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	0.5	500	10	2500	1523	2.08	952	1542	2.54-2.64	968-970

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBM development, but are expected to be affected by CBM wells on Indian Lands and state and fee lands in Montana.

The resultant surface water impacts to the Bighorn Rivers would be similar to but less than Alternative C. This is due to the fact that the SQWATR indicates that approximately 60% of the produced water could be discharged in the upper portion of this watershed (Hardin and Wyola stations) without exceeding the LRPL. All projected produced water could be discharged in the downstream portion of the watershed (Bighorn station). The actual volume of water that is allowed to be discharged will depend on the final numeric water quality standards set by the Montana Board of Environmental Review, and the MPDES permit program administered by the MDEQ. CBM discharge volumes will be dependent on site-specific conditions and the approval of a WMP. In order to be approved the WMP would need to show how the produced water could be managed without impacting beneficial uses. These results are shown in Table 4-36 and can be compared to the following surface water criteria:

- MRPL: The most restrictive proposed standards are set at a SAR of 0.5 and an EC of 500 µS/cm for the Bighorn Rivers. These criteria are exceeded by natural conditions in these rivers for several months out of the year. Thus, these rivers could not receive any CBM discharges if these standards were adopted. The forecasted impacts under Alternative E are therefore also in excess of these criteria.
- LRPL: The least restrictive proposed standards are set at a SAR of 10 and an EC of 2500 µS/cm. These criteria would only be exceeded during 7Q10 flows, and only at the upstream stations under this alternative.
- Ayers and Westcot: Predicted water qualities would only exceed this criterion during 7Q10 flows, and only at the upstream stations under this alternative.

There would be no impact to beneficial uses under this alternative.

Surface disturbance, as itemized in Table 4-37, indicates that approximately 1,516 acres of short term disturbance, and 1,129 acres of long term disturbance would result from water management practices under this alternative in this watershed of approximately 208,000 acres (ALL 2001b).

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBM wells, and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no discharge of Montana CBM water into Rosebud Creek under the analysis of the Preferred Alternative. For comparison purposes, these forecasted effects are summarized on Table 4-38. The effects on Rosebud Creek would be the same as those for Alternative A, since no additional Montana discharges to Rosebud Creek are assumed under this alternative. A comparison to surface water quality criteria is provided in the discussion of Rosebud Creek under Alternative A. As there would be no discharge under this alternative there would be no degradation of beneficial uses. Table 4-39 provides an estimated of disturbances that would result from water management practices. By this estimate, approximately 11,217 acres of short-term surface disturbance will occur and approximately 8,987 acres of long term disturbance will occur. The drainage is approximately 814,000 acres in size (ALL 2001b).

Little Powder River

The effects on the Little Powder River surface water quality at the Weston, Wyoming, station would be the same as Alternative A, since there are no Montana wells discharging upstream of this station. The effects from Montana wells downstream of this station are calculated in the analysis for the Powder River at Locate station. The Preferred Alternative assumes untreated discharge of all anticipated CBM water in this watershed without impacting current beneficial uses. Local conditions could restrict this activity, and water management practices would need to be addressed and approved in a WMP.

Powder River

The Preferred Alternative E assumes that 100% of the Montana CBM water would be discharged to the watershed. The impacts to the Powder River watershed are shown in Table 4-40; impacts will come from discharges to the river from Wyoming CBM development as well as Montana development. These resulting surface water qualities can be compared to the following surface water criteria:

- MRPL: The most restrictive proposed standards are set at a SAR of 2 and an EC of 1000 µS/cm for the Powder River. The natural conditions in this river are well in excess of these criteria. Therefore this river could not receive any CBM discharges if these standards were adopted and the forecasted impacts under Alternative E are also in excess of these criteria.

TABLE 4-37
WATER MANAGEMENT FRAMEWORK FOR THE BIGHORN RIVER WATERSHED UNDER THE PREFERRED ALTERNATIVE E

Method	Volume to be Managed (gpm)	Rate Managed Per Site (gpm)	Number of Sites Needed	Acres Disturbed Short Term Per Site	Acres Disturbed Long Term Per Site	Cumulative Short Term Impacts	Cumulative Long Term Impacts
Beneficial Use	2,342	--	--	--	--	--	--
Infiltration Basins	1,874	9	208	6	5	1,248	1,040
Shallow Injection Wells	1,874	21	89	3	1	267	89
Surface Discharge	5,622	100	56	0.01	0.002	1	1
Water Treatment	0	900	0	15	10	0	0
Evaporation Basins	0	4.1	0	6	5	0	0
Total	**11,712**					**1,516**	**1,129**

TABLE 4-38
EFFECTS ON SURFACE WATER IN THE ROSEBUD CREEK UNDER THE PREFERRED ALTERNATIVE E

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative E		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Rosebud Creek at Kirby	1	500	10	3000	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	1	500	10	3000	8.42	4.84	1780	8.42	4.84	1780

TABLE 4-39
WATER MANAGEMENT FRAMEWORK FOR THE ROSEBUD CREEK DRAINAGE UNDER THE PREFERRED ALTERNATIVE E

Method	Volume to be Managed (gpm)	Rate Managed Per Site (gpm)	Number of Sites Needed	Acres Disturbed Short Term Per Site	Acres Disturbed Long Term Per Site	Cumulative Short Term Impacts	Cumulative Long Term Impacts
Beneficial Use	4,912	--	--	--	--	--	--
Infiltration Basins	7,367	9	842	6	5	5,052	4,210
Shallow Injection Wells	4,912	21	232	3	1	696	232
Surface Discharge	0	100	0	0.01	0.002	0	0
Water Treatment	3,684	900	5	15	10	75	50
Evaporation Basins	3,684	4.1	899	6	5	5,394	4,495
Total	**24,559**					**11,217**	**8,987**

TABLE 4-40
EFFECTS ON SURFACE WATER IN THE POWDER RIVER UNDER THE PREFERRED ALTERNATIVE E

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative E		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Powder River at Moorhead	2	1000	10	3000	145	4.65	2154	231	11.08 - 11.56	2226 - 2253
Powder River at Locate	2	1000	10	3000	143	4.61	2287	250	11.97 – 13.13	2323 - 2361

- LRPL: The least restrictive proposed standards are set at a SAR of 10 and an EC of 3200 µS/cm. According to this surface water model these criteria would be exceeded during 5 of the 12 months of the average year as well as 7Q10 flows under this alternative, with the majority of this alteration being due to CBM discharges in Wyoming.
- Ayers and Westcot: This criterion would only be exceeded during 7Q10 flows under this alternative.

The Powder River watershed is unique to the PRB in Montana; the existing water is seasonally variable and often of low quality, there is significant CBM discharge to this river in Wyoming at the present time that does not appear to be impacting the river [see Appendix E in the SWQATR Greystone, 2002)], and CBM water quality data in the Montana portion of the watershed is limited. For these reasons the possibility for 100% discharge is assumed. Of course site-specific conditions and the actual surface water standards adopted by the Montana Board of Environmental Quality will be the most important factors in determining the actual water management practices within the Montana portion of the PRB. The MDEQ cannot allow discharges of CBM water to impact surface water conditions in excess of prevailing regulations and standards. This process may require the use of other water management practices such as water treatment or infiltration basins in this watershed. CBM producers in the Wyoming portion of this watershed will be held to the same standards once the Montana standards are approved by the EPA and given Clean Water Act standing.

In order to manage the Montana CBM discharge, approximately 1.0 acre of short term, and 1.0 acre of long term disturbance would occur in the Powder River watershed, which has a total area of approximately 368,500 acres. (ALL 2001b).

Mizpah Creek

Table 4-41 illustrates the small amount of water within Mizpah Creek. Only 125 Montana CBM wells are projected to be productive in this watershed; and there are no Wyoming CBM wells. Impacts are expected to be the same under Alternative E as under Alternative A, since no CBM produced water could be discharged under this alternative. The surface disturbing activities associated with water management in the Mizpah watershed is included in the water management framework for the Powder River watershed (Table 4-42) and also analyzed separately for the Mizpah watershed on Table 4-43.

Beneficial uses would not be reduced.

The water management scenario is detailed in Table 4-43. The necessary discharge facilities would require approximately 201 acres of short-term disturbance and 159 acres of long-term disturbance in a watershed of approximately 24,000 acres (ALL 2001b).

Yellowstone River

The Yellowstone River receives the combined flows of all the other watersheds in the Montana portion of the Powder River Basin. The Forsyth station is the upstream station which receives no contribution from Wyoming discharges, but will receive some MT CBM discharge. The Sidney station is the downstream station and it will receive discharges from all Montana

Powder River Basin wells and approximately 21,391 CBM wells from the Wyoming portion of the Powder River Basin under Alternative E. The effects to the Yellowstone River would be less than those indicated for Alternative C as the volume of CBM water discharged to tributaries of the Yellowstone would be limited. Table 4-44 summarizes the effects of these discharges on the Yellowstone River. These resultant surface water chemistries can be compared to the following criteria.

- MRPL: The most restrictive proposed standards are set at a SAR of 0.5 and an EC of 500 μS/cm for the Yellowstone River. These criteria are exceeded by natural conditions in this river for several months out of the year. Thus, this river could not receive any CBM discharges if these standards were adopted. The forecasted impacts under Alternative E are therefore also in excess of these criteria.

TABLE 4-41
EFFECTS ON SURFACE WATERS OF MIZPAH CREEK DRAINAGE UNDER THE PREFERRED ALTERNATIVE E

	Most Restrictive Proposed Limits (MRPL)		**Least Restrictive Proposed Limits (LRPL)**		**Existing Stream Water Quality and Quantity (Min Mean Monthly)**			**Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative A**		
Station	**SAR**	**EC**	**SAR**	**EC**	**Flow**	**SAR**	**EC**	**Flow**	**SAR**	**EC**
Mizpah Creek at Mizpah	3	1000	10	3000	0.26	16.6	3503	0.26	16.6	3503

TABLE 4-42
WATER MANAGEMENT FRAMEWORK FOR THE POWDER RIVER WATERSHED UNDER THE PREFERRED ALTERNATIVE E

Method	**Volume to be Managed (gpm)**	**Rate Managed Per Site (gpm)**	**Number of Sites Needed**	**Acres Disturbed Short Term Per Site**	**Acres Disturbed Long Term Per Site**	**Cumulative Short Term Impacts**	**Cumulative Long Term Impacts**
Beneficial Use	1,765	--	--	--	--	--	--
Infiltration Basins	0	9	0	6	5	0	0
Shallow Injection Wells	0	21	0	3	1	0	0
Surface Discharge	7,058	100	71	0.01	0.002	1	1
Water Treatment	0	900	0	15	10	0	0
Evaporation Basins	0	4	0	6	5	0	0
Total	**8,823**					**1**	**1**

TABLE 4-43
WATER MANAGEMENT FRAMEWORK FOR THE MIZPAH CREEK DRAINAGE UNDER THE PREFERRED ALTERNATIVE E

Method	Volume to be Managed (gpm)	Rate Managed Per Site (gpm)	Number of Sites Needed	Acres Disturbed Short Term Per Site	Acres Disturbed Long Term Per Site	Cumulative Short Term Impacts	Cumulative Long Term Impacts
Beneficial Use	82	--	--	--	--	--	--
Infiltration Basins	123	9	14	6	5	8	70
Shallow Injection Wells	82	21	4	3	1	12	4
Surface Discharge	0	100	0	0.01	0.002	0	0
Water Treatment	61	900	1	15	10	15	10
Evaporation Basins	61	4	15	6	5	90	75
Total	**409**					**201**	**159**

TABLE 4-44
EFFECTS ON SURFACE WATER IN THE YELLOWSTONE RIVER UNDER THE PREFERRED ALTERNATIVE E

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly) Under Alternative E		
Station	**SAR**	**EC (µS/cm)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**	**Flow (cfs)**	**SAR**	**EC (µS/cm)**
Yellowstone at Forsyth, Montana	0.5	500	10	2500	5820	1.99	745	5850	2.22 – 2.18	753 – 754
Yellowstone at Sidney, Montana	0.5	500	10	2500	5764	2	870	5850	2.54 – 2.60	891 – 893

- LRPL: The least restrictive proposed standards are set at a SAR of 10 and an EC of 2500 µS/cm. All mixed water qualities are below these limits.
- Ayers and Westcot: Predicted water qualities would not exceed this criterion even during 7Q10 flows.

Although discernable effects may be seen at Forsyth and Sidney, beneficial uses would not be reduced under Alternative E.

The overall assumed water management practices for the Montana portion of the Powder River Basin, all of which is drained by the Yellowstone River, is presented in Table 4-45. Approximately 37 percent of the water produced would recharge local aquifers through infiltration and injection under this alternative. The short-term surface disturbances caused by various water management practices in the Montana portion of the basin include approximately 26,867 acres, while the long-term disturbances are approximately

TABLE 4-45
WATER MANAGEMENT FRAMEWORK FOR THE YELLOWSTONE WATERSHED UPSTREAM SIDNEY, MT (ALL OF THE MONTANA PRB) UNDER THE PREFERRED ALTERNATIVE E

Method	Volume to be Managed (gpm)	Rate Managed Per Site (gpm)	Number of Sites Needed	Acres Disturbed Short Term Per Site	Acres Disturbed Long Term Per Site	Cumulative Short Term Impacts	Cumulative Long Term Impacts
Beneficial Use	15,757	--	--	--	--	--	--
Infiltration Basins	19,348	9	2,206	6	5	13,160	11,030
Shallow Injection Wells	13,524	21	639	3	1	1,917	639
Surface Discharge	14,280	100	138	0.01	0.002	3	3
Water Treatment	7,937	900	11	15	10	165	110
Evaporation Basins	7,937	4	1937	6	5	11,622	9,685
Total	**78,783**					**26,867**	**21,467**

21,467 acres. The total acreage of the area is approximately 4.1 million acres (ALL 2001b). The short-term disturbances total approximately 0.65 percent of the total Montana PRB area, the long-term disturbances total even less.

Summary of Surface Water Impacts

A summary of calculated surface water effects by USGS station for the preferred alternative is shown in Table 4-46.

The table summarizes effects of forecast discharges of CBM water from the Wyoming Alternative 2A and Montana Preferred Alternative E for watersheds in the Montana portion of the Powder River Basin. Surface water quality in some watersheds would be slightly reduced; however, downstream uses would not be diminished. Surface water flow would be moderately increased causing some riparian erosion, as well as increased sedimentation.

Abandonment

Impacts to water resources due to abandonment operations would be similar to impacts under Alternative B. When the estimated 16,500 CBM production wells are abandoned over the 20-year project life, 33,000 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on Crow Tribal Lands under Alternative E would be similar to, but less than, those effects noted in Alternative C. Because of the latitude in produced water management, effects would be lessened by the wider variety of water management options. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. The monitoring would track drawdown of aquifers from CBM production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBM wells on federal leases would be restricted.

Northern Cheyenne

Surface water effects to Northern Cheyenne Tribal Lands under Alternative E (Preferred Alternative) would be similar to those impacts noted in Alternative A, since no additional direct discharge of CBM water is assumed occur into the Tongue River or Rosebud Creek. The beneficial use of the Tongue and Rosebud streams would be maintained under Preferred Alternative E.

CBM developments have the potential to impact groundwater resources under Northern Cheyenne Tribal Lands. Groundwater impacts within the reservation boundary would be detected and managed by monitoring the magnitude of aquifer drawdown.

TABLE 4-46
CUMULATIVE IMPACTS ON SURFACE WATERS UNDER WYOMINGS' ALTERNATIVE 2A AND MONTANAS' ALTERNATIVE E

	Most Restrictive Proposed Limits (MRPL)		Least Restrictive Proposed Limits (LRPL)		Existing Stream Water Quality and Quantity (Min Mean Monthly)			Resulting Stream Water Quality and Quantity (Min Mean Monthly)		
Station	**SAR**	**EC (μS/cm)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**	**Flow (cfs)**	**SAR**	**EC (μS/cm)**
Tongue River at Stateline Near Decker	0.5	500	10	2500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	0.5	500	10	2500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Montana	0.5	500	10	2500	207	1.36	1016	214	2.5	1058
Little Bighorn River at Wyola	0.5	500	10	2500	110	0.53	548	115	2.26 – 2.64	623 - 632
Little Bighorn River at Hardin	0.5	500	10	2500	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	0.5	500	10	2500	1523	2.08	952	1542	2.54-2.64	968-970
Rosebud Creek at Kirby	1	500	10	3000	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	1	500	10	3000	8.42	4.84	1780	8.42	4.84	1780
Little Powder River Stateline Weston,	3	1000	10	3000	2.6	6.94	3300	16	10.41	1606
Powder River at Moorhead	2	1000	10	3000	145	4.65	2154	231	11.08 – 11.56	2226 - 2253
Powder River at Locate	2	1000	10	3000	143	4.61	2287	250	11.97 – 13.13	2323 - 2361
Mizpah Creek at Mizpah	3	1000	10	3000	0.26	16.6	3503	0.26	16.6	3503
Yellowstone at Forsyth, Montana	0.5	500	10	3000	5820	1.99	745	5850	2.18 – 2.22	753 – 754
Yellowstone at Sidney, Montana	0.5	500	10	3000	5764	2	870	5850	2.54 – 2.60	891 - 893

The monitoring wells would be engineered and placed to best intercept drawdown effects from CBM development. Nests of monitoring wells will be used to track drawdown of multiple producing coal seams. To this end, the USGS is currently installing six well clusters along the southern boundary of the Northern Cheyenne Reservation to track drawdown effects from CBM development east of the CX Ranch and nearby areas. The BLM is also installing monitoring well clusters throughout the Montana portion of the Powder River Basin, including areas adjacent to the Northern Cheyenne and Crow Reservations. The BLM wells will provide regional hydrological information as well as locally important data. In addition, CBM operators may be required to install additional monitoring wells adjacent to proposed producing wells. The entire monitoring well network would monitor drawdown of coal seams and surface aquifers due to CBM production on federal, state, and fee leases outside the reservation boundary. Monitoring well data would be placed in the public record by the USGS, the BLM, and responsible state agencies where it can be accessed and used by Tribal officials as well as agency staff.

If drawdown is detected on the Reservation, the production rate of CBM wells operated on federal leases would be restricted until mitigation measures can be put into place. Mitigation measures could include curtailment of CBM production, replacement of affected water wells or springs, or a hydrologic barrier engineered to reduce additional drawdown. The BLM would use all reasonable means to assure that Reservation groundwater is not adversely affected by off-Reservation CBM production. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBM wells on nearby state and fee leases to drawdown groundwater within the reservation boundaries.

Conclusion

Effects of the Preferred Alternative to groundwater will be the same as Alternative B. Minor effects on shallow groundwater quality from impoundment infiltration and surface discharge of some untreated production water would also occur. The operator's WMPs would result in increased beneficial use of produced CBM water, estimated to total at least 20 percent.

Surface water effects would be the same as Alternative A for the Tongue River, Rosebud Creek, Little Powder River, and Mizpah stations. Surface water effects would be the same as Alternative C for the Powder River. Effects to the Yellowstone, Little Bighorn, and Bighorn rivers would be similar to, but less than, those identified under Alternative C. Even where discharge is an available option operators may choose other options when managing their CBM water with simultaneous reductions in the volume of surface discharge. Consultation with state and federal agencies charged with managing Wyoming's resources have allowed close cooperation and improved estimation of likely impacts to the surface waters of Montana from CBM and other activities under this alternative. The cumulative impacts to surface water and groundwater further depend upon WDEQ's and MDEQ's Water Quality Agreement, as well as MDEQ non-degradation numerical standards. Anticipated impacts under this alternative include slight alteration of surface water quality, without diminishing downstream use.

Weathered landscape with exposed Fort Union Formation

Indian Trust and Native American Concerns

Indian Trust Assets
Indian Trust Assets (ITAs) are official interests in assets held in trust by the federal government for Indian tribes or individuals. The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines ITAs as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians.

Alternative A
No Action (Existing CBM Management)

- No measurable impacts to Indian trust impacts would occur from the CBM activities.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  - No surface water quality impacts.
  - Potential CBM drainage, dependent on specific site conditions, delayed by buffer zone.
  - Air Quality impacts to reservation PSD Class I areas.
  - Visibility impacts.
  - Potential cultural resource impacts to TCPs
- State:
  - Groundwater drawdown inward from reservation boundaries.
  - Potential CBM drainage, dependent on specific site conditions, no delay due to adjacent development.

Alternative C
Emphasize CBM Development

- Federal:
  - Potential for surface water quality and quantity impacts.
  - Potential CBM drainage, same as Alternative B.
  - Cultural Resource impacts same as B.
  - Air quality and visibility impacts same as Alternative B.
- State:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality and quantity impacts.
  - Potential CBM drainage, same as Alternative B.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Federal:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality impacts reduced by source treatment, increased availability of surface waters for irrigation and other beneficial uses
  - Increased surface water flow could in increase riparian erosion.
  - Potential CBM drainage, same as Alternative B.
  - Cultural Resource impacts same as B.
  - Air Quality and visibility impacts reduced.
- State:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality impacts reduced.
  - Potential CBM drainage, same as Alternative B.

Alternative E
Preferred CBM Development Alternative

- Federal:
  - Effects from groundwater drawdown substantially reduced by resource protection protocols. Potential CBM drainage mitigated or compensated.
  - Surface water quality impacts reduced, with increased availability of surface waters for irrigation and other beneficial uses.
  - Increased surface water flow could increase riparian erosion.
  - Air Quality impacts mitigated through site specific permits and control measures.
- State:
  - Groundwater drawdown potential on the reservations would be minimized. CBM drainage minimized by state spacing.
  - Surface water quality protected.

Assumptions

The BLM's responsibilities include identifying and protecting Tribal resources and trust assets from impacts resulting from BLM actions. The state does not have a trust responsibility similar to the federal governments. The 2-mile buffer zone around the reservations as called for in the management objectives for Alternatives B and D would only apply to federal leases.

Impacts From Management Common to All Alternatives

While the BLM would not have jurisdiction over Indian lands located on or off the reservation, the BLM would have a trust responsibility that encompasses oil and gas exploration. Indian Trust Assets (ITAs) would be managed following the DOI Secretarial Order 3215, Principles for the Discharge of the Secretary's Trust Responsibility.

The conventional wells expected to be drilled on BLM-administered lands could impact adjacent reservation lands by draining tribal hydrocarbons or groundwater, or even by allowing produced water to impact surface water resources or soil. Drainage by adjacent wells is addressed by 43 CFR Part 3162.2-2, which instructs the BLM on steps to be taken to protect Indian landowners from drainage.

The number of conventional wells estimated for reservation development (12) coupled with the predicted wells (less than 25) adjacent to reservation lands, do not represent a measurable increase in development on or near the reservation for the next 20 years. This level of development would not impact tribal hydrocarbons or effect groundwater resources. The direct land impacts from this small number of wells on reservation lands would be minor (less than 75 total acres impacted) with regard to grazing lands, vegetation, and biological resources.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

There would not be any impacts to measurable ITAs from the CBM activities planned under this alternative.

This is based on the limited development scenario under this alternative, the known locations of production wells (CX Ranch), and the number of exploration wells..

Conclusion

There would not be any impacts to ITAs from management decisions under Alternative A or from management practices common to all alternatives. Cumulative effect impacts could result from the Absaloka Coal Mine and the production and discharge of CBM production waters from Wyoming.

Mining activities at the 5,400-acre Absaloka Coal Mine facility located just north of the northeastern corner of the Crow Reservation has resulted in the irretrievable loss of the coal mined at approximately 5 million tons per year, and has removed or disturbed approximately 3,150 acres of topsoil. Additional impacts have occurred from the dewatering of the coal that lowered the surrounding groundwater by an estimated 75 feet (Wheaton and Van Voast 1998). Finally, the surface water within the vicinity of the mine has undergone a reduction in quality, resulting in impacts on the local watercourses and subsequent fields using these waters as sources of irrigation.

Development of CBM in Wyoming during the next 20 years has the potential to impact the surface water, groundwater, and methane resources of the Crow and Northern Cheyenne tribes. Drawdown of groundwater levels is an unavoidable impact from CBM development. Increased groundwater drawdown would be experienced in coal seam aquifers along the southeastern border of the Crow Reservation adjacent to and up to 5 miles north of the Wyoming state line (Wheaton and Metesh 2001). The magnitude of impact to water wells and springs would depend on the location and number of CBM producing wells south of the state boundary. Depending upon their locations, natural springs and water wells on tribal lands could go dry.

Wyoming CBM production could also drain methane from tribal mineral resources. As groundwater is drawn down and reservoir pressures decrease, methane is liberated from the coal matrix and becomes free to be produced or migrate. Two- dimensional modeling (Crockett and Meyer 2001) suggests that drainage of methane could occur at distances more than 5 miles from a producing CBM field. Recent three-dimensional modeling suggests that the methane drainage effect is less than 2 miles. This is based on the model results indicating that 80 feet of water would be drawn down at 2 miles from the edge of a producing field (Wheaton and Metesh 2002). In either case, the Crow Reservation is adjacent to the Wyoming boundary and is close enough to be drained by CBM wells that may be drilled in Wyoming.

Full-scale CBM production in the Wyoming portion of the Powder River Basin would result in limited surface discharge and infiltration of produced water to streams that flow north into Montana. Expected levels of development would result in volumes of discharged water causing a slight increase in annual flow rates of the Powder, Little Powder, and Tongue Rivers. A corresponding slight alteration in the quality of surface water would also be felt downstream from these Wyoming discharges. The percent increase in flow volume would be greater during periods of low-flow. This alteration may require downstream users to implement minor management changes. Impacts to the Tongue Rivers would be felt by the Northern Cheyenne and Crow members who use river water for irrigation. Detailed discussions regarding surface water quality and flow changes are presented in the Hydrologic Resources section of this chapter.

The Bighorn and Little Bighorn rivers carry high quality water from the Bighorn Mountains north into Montana. No CBM wells in Wyoming or Montana would impact these rivers under Alternative A. Stream water quality and flow volume would remain unchanged.

The Northern Cheyenne have a large reserved water right in the Tongue River Reservoir. That stored water represents a marketable commodity and if it were to experience even a slight decrease in quality, it would affect the tribes' ability to market or use the water. Under this full-scale Wyoming development scenario, it is conceivable that the reservoir water quality could be slightly altered.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Based on the development scenario presented in Alternative B and on the management objectives described under this alternative, potential impacts on ITAs include the drawdown of groundwater, alterations in surface water quality, air quality changes, potential social and cultural impacts, potential wildlife adaptation, and the drainage of Tribal CBM.

A 20 foot drawdown of the groundwater table within the vicinity of a producing Montana CBM field has been modeled (3D) by the MBMG at between 4 to 5 miles from the edge of production (Wheaton and Metesh 2002). Without site-specific information, it is impossible to predict the degree of drawdown to a neighboring aquifer. In the case of the Crow and Northern Cheyenne, it is conceivable that the reservations' groundwater would be drawn down to some extent along the boundaries by both state and BLM-leased development. The drawdown of groundwater within the reservation could result in impacts on shallow stock and domestic wells and some surface springs. These impacts would reduce water pressure and in some cases could render the complete loss of water from a well or spring.

The recognition of a 2-mile buffer zone around the reservations would effectively reduce and delay the drawdown that would be experienced by the tribes in these areas from BLM leased mineral development. In the case of development on either private or state fee lands, the state would not be subject to the same buffer zone restrictions, and therefore, the drawdown could be generated earlier and be to a greater horizontal and vertical extent. The effect of these combined drawdowns would create a long-term impact to the groundwater level.

The alteration of surface water quality from the management objectives in this alternative is almost negligible because the alternative calls for the injection of all produced water and the storage of all waters generated during exploration well tests. However, the potential exists for localized, short-term (less than 1 year) impacts from spills and ruptures associated with these water disposal methods. Undetected ruptures along water conduits feeding injection wells also would impact soils and create erosion problems within the immediate vicinity. These impacts are not expected to reach reservation lands under this management objective. Only the spilled or released waters entering associated watersheds near the reservations would be affected.

Numerous social and cultural impacts have been predicted by Native Americans as a result of CBM development on adjacent fee, state, and federal minerals. These potential impacts include the lack of access to well-paying energy-related employment contributing to the reduced annual Native American income; over-commitment of Tribal revenues; population influx; abridged effectiveness of Tribal governments; stressed infrastructure and service-related capacity; altered social organization and social well-being perception; and the further influence of western culture resulting in changes to traditional belief and value systems.

Off-reservation cultural and paleontological artifacts also run the risk of being damaged or lost due to the increased access and land-disturbing activities associated with full-scale development. TCPs may be affected as development expands. These impacts would be minimized through survey and consultation with the tribes.

Wildlife would adapt to the CBM development infrastructure in ways that could be interpreted as negative or positive. For example, depending on one's perspective, big game migratory paths could shift resulting in greater opportunities for tribal outfitters and tribal hunters or diminished chances for euro-American outfitters and hunters. This scenario could result in reduced herd strength or increased susceptibility could also be viewed as a negative outcome or singularity. Given the various and complex perspectives, wildlife impacts need to be assessed on a case-by-case basis as individual CBM actions are reviewed.

CBM development would threaten to drain methane resources under tribal lands in the planning area. Drainage of CBM resources from Native American minerals is dependent upon local reservoir parameters. It is assumed that a single CBM well would drain the methane from a single coal seam over an 80-acre unit. Research by the BLM in the Wyoming portion of the Powder River Basin, however, suggests that drainage may be across a broader radius (Crockett and Meyer 2001) from BLM, private, or state lands. The Wyoming BLM estimates that considerable methane drainage happens when 40 percent of the hydrostatic head is removed from the coal aquifer. Modeling by the MBMG (Wheaton and Metesh 2002) suggests that the hydrostatic head of a producing coal seam could be reduced sufficiently to cause methane liberation at a distance of approximately 2 miles from the edge of a producing CBM field. The reduction of hydrostatic pressure achieved by lowering the water table within a specific coal seam is necessary for CBM production. This reduction liberates the methane held in the coal matrix; however, the complex, site-specific aquifer conditions dictate the actual radius of methane drainage. Therefore, conclusions regarding methane drainage from tribal minerals need to be made on a case-by-case basis during development.

The reduction of the hydrostatic pressure in a coal seam and the resulting liberation of CBM could also cause the methane to migrate along the path of least resistance and appear as an unchecked seepage at the surface. This scenario would be unlikely in view of the depths of the coal seams being explored (greater than 500 feet below the ground surface), the distance of foreseeable producing fields to the reservations and the relatively shallow groundwater wells used on the reservations for water production.

This alternative calls for the directional drilling of deeper coal seams, multiple completions in a single well bore, and the simultaneous development of all coal seams within a field. These techniques would increase the likelihood that CBM would be drawn from adjacent Indian mineral resources. Detailed explanations for these potential impacts can be found in the Hydrology, Geology and Minerals, and Air Quality sections of this Chapter.

Mitigation agreements would be used to replace water lost from the drawdown of groundwater within aquifers impacted by CBM production. These agreements would call for the replacement of the groundwater wells at the operator's expense. Another mitigation measure for large-scale groundwater drainage to the reservations is the installation of a hydraulic barrier between the production field and the reservation boundary. BLM would apply this mitigation measure to reduce and delay any water drainage from the Indian reservations. Although hydraulic barriers have been used successfully to prevent migration of brackish or salty waters into drinking water resources, more research would be required to determine if they could be employed successfully in the coal seam aquifers of the Powder River Basin to prevent loss of groundwater resources.

Surface water discharge permits that limit the quantity of CBM-produced water that is discharged would mitigate the impacts from Wyoming CBM production, as well as from expanded CX Ranch production. Potential hydrocarbon migration would be the subject of detailed monitoring and periodic drainage analysis conducted by the BLM as part of their trust responsibility (See Monitoring Appendix for details and frequency of monitoring). Monitoring and conducting drainage analysis would reduce the likelihood for drainage of Tribal CBM resources. Native American development of reservation CBM resources is another potential mitigation measure that would ensure the Tribes receive their fair share of the CBM revenues.

Conclusion

Impacts from management decisions included in Alternative B, would result in impacts to surface water quality, groundwater availability, cultural artifacts and sites, wildlife, air quality, visibility, and the irreversible loss of fluid and solid minerals.

The surface water quality impacts would be similar to those described under Alternative A, with only slight alterations to current quality.

The water drawdown from Montana CBM development under Alternative B, coupled with the development of CBM on the reservations, would result in a more widespread effect than just adjacent to the reservation boundaries. Considering the location of known coal occurrences, the groundwater drawdown would be experienced generally along the eastern portion of the Crow Reservation and across the entire Northern Cheyenne Reservation. The water drawdown would be contingent on the continuity of the coals, many of which are fractured, crop out, pinch out or have shale stringers. Impacts could not be detailed until the fields are developed. Under any scenario of development, the BLM would take measures to mitigate reservation groundwater drawdown resulting in no contributing influences from federal mineral development.

Associated with the development of full-scale CBM production across the Powder River Basin are a network of gas compressors and other small emission sources that could contribute to air quality changes in the region. The non-project sources combined with the project sources to form a cumulative effect that contributions to changes in air quality. These changes could add to the pollutant concentration, possibly exceeding the Northern Cheyenne's PSD Class I area for the annual NO_2 and 24-hour PM_{10} increment standards. If site- specific analysis indicates these contributions would add to the pollutant concentration on the Lame Deer nonattainment area resulting in an exceedance, the tribe, state and the Federal Government would require mitigation measures to reduce and control the contributing sources of CBM emissions.

The Crow Reservation would experience similar changes in air quality, but due to the reservation's classification as a PSD Class II area would not likely experience any exceedance of standards.

With regards to visibility, the air model indicates that the Crow and Northern Cheyenne, as well as the Fort Belknap reservation, would experience some form of reduced vision or increased haze. Visibility impacts would increase under predicted cumulative impacts from project and non-project emissions. For more detailed discussions regarding Air Quality changes to the reservations see the Air Quality section of this chapter.

Potential effects to cultural artifacts, TCPs, and wildlife would be mitigated by site-specific protective and control measures developed to reduce and/or eliminate detrimental changes.

Alternative C—Emphasize CBM Development

The differences in management objectives for Alternative C that would affect ITAs are the direct discharge of a portion of untreated production water, and to some extent, the removal of the directional drilling and multiple completion requirements. Impacts to air quality, visibility, cultural resources, wildlife, and social services and infrastructure would be the same or similar to those described for Alternative B.

Important to note is that, depending on the water quality criteria developed by the MDEQ, various levels of impacts on surface water would occur. If the criteria imposed were to be relatively conservative, the discharge of CBM produced water would be limited into watersheds of both low and high water quality, resulting in minimal surface water quality impacts and increased treatment and use of alternative disposal methods. On the other hand, if the criteria were to be somewhat liberal and allow untreated discharge of produced CBM water into watersheds of higher quality, then impacts such as the following would be experienced: increased soil erosion and a corresponding increase in the addition of suspended sediment to surface waters adjacent to CBM development; the elevation of existing SAR, EC, and bicarbonate values for streams and rivers used by the tribes for irrigation; and the increase in flow that would result in riparian erosion and river course changes. These impacts are discussed in further detail in the *Hydrology* section of this chapter.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B. The development of federal minerals near the reservations would increase the rate at which the groundwater is removed and discharged to the surface. Additionally, impacts on shallow aquifers from the infiltration of untreated produced water are expected where the soils have a coarser texture (sandy to loamy) and good internal drainage (ALL 2001a), which would allow infiltration of produced water into subsoil-thereby impacting shallow aquifers. Some of the shallow aquifers adjacent to reservation boundaries would be affected by this type of short-term infiltration.

The discharge of untreated produced water into drainages and ephemeral watercourses adjacent to well sites would cause an overall increase in erosion leading to gullying. Based on the *Soils Technical Report* (ALL 2001a), much of the soil would likely be susceptible to increasing sodicity when irrigated or land applied with water having a high SAR (generally greater than 12). The long-term consequence is an anaerobic, waterlogged, saline/sodic soil that can be reclaimed, but would be very difficult to mitigate.

Drainage of Native American CBM resources by adjacent production would be similar to that described for Alternative B for adjacent production. Site-specific conditions control methane liberation and collection and therefore, to evaluate potential drainage, a case-by-case drainage determination is necessary.

Encroachment on the Absaloka Coal Mine by CBM development would inhibit future coal resource recovery. Impacts associated with the groundwater drawdown would also occur. This is discussed further in the *Geology and Minerals* section of this chapter.

Conclusion

Impacts from management decisions included in Alternative C would result in impacts to surface water quality. State and fee development would reduce groundwater availability and cause the irreversible loss of fluid minerals.

The impacts to surface water quality would be greater than described in Alternative B, but the biggest factors influencing water quality would be the creation of a Water Quality Agreement between Montana and Wyoming, and the implementation of water quality criteria regarding degradation of Montana watersheds by the DEQ. CBM development on reservations would further increase the SAR value of available surface waters, adding to the chain reaction of impacts associated with erosion, sedimentation, riparian damage, and land use applications.

Impacts on the Northern Cheyenne's water right in the Tongue River Reservoir would be as described under Alternative A.

Impacts on groundwater drawdown and availability would be similar to those explained under Alternative B. Drawdown adjacent to the reservations would be increased.

Monitoring and drainage analysis would be necessary to evaluate the case-by-case CBM drainage of adjacent fields. As stated under Alternative B, the timely development of CBM on reservations would reduce the potential for adjacent mineral drainage, but would increase the likelihood of proximity-related impacts to the Absaloka Coal Mine.

The impacts on lands irrigated by streams and rivers receiving untreated CBM discharge would be as described in the *Soils Technical Report* (ALL 2001a), and would be greatly dependent on the altered quality of the particular watershed being used. Increased soil erosion leading to gullying would be a result of development on the reservations along with erosion outside reservation boundaries.

Impacts to air quality, visibility, cultural resources, wildlife, social services, and infrastructure would be the same or similar to those described for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The only differences in management objectives for Alternative D that would have an effect on ITAs is the treatment and piped conveyance of production water. This difference would reduce the impacts to erosion along ephemeral drainages, lower the sediment load in watercourses, and limit the water quality impact to both surface water and groundwater. There would be an increase in available surface water for beneficial reuse because of the required treatment and lack of conveyance losses from the piped system of discharge. The lack of conveyance losses would increase the flow in receiving watercourses resulting in course changes and riparian alterations, as identified in Alternative A.

Groundwater drawdown would be as described in Alternative B because of the use of the buffer zone by the BLM. Mineral drainage also would be the same as discussed under Alternative B, with the use of monitoring required to evaluate the case-by-case field conditions. Irrigated lands would be less affected by the use of treated waters, as described in the *Soils* section of this chapter. The Absaloka Coal Mine would experience the same groundwater drawdown impacts as described under Alternative B. Impacts to visibility, cultural resources, wildlife, social services, and infrastructure would be the same or similar to those described for Alternative B on all reservations. Impact to air quality on all reservations would be lower than Alternative B.

Conclusion

Impacts from management decisions included in Alternative D, management practices common to all alternatives, and from projects evaluated under the cumulative effects analysis would result in increased surface water flow, reduction of groundwater availability, and the irreversible loss of fluid minerals.

Impacts on surface water quality would be similar to those discussed under Alternative B with regard to the influence of Wyoming's CBM production waters entering Montana and affecting the Northern Cheyenne water right in the Tongue River Reservoir. With the increase in flow from the treated waters in Montana, the overall SAR values would be adjusted downward, but only slightly. CBM development on reservations would further add to available surface waters once treatment is administered; groundwater drawdown would be the same as discussed in Alternative B. Soil erosion would be decreased because of the use of conveyance systems, which would result in the reduction of suspended solids in watercourses and the elimination of gullying. The impacts on lands irrigated by streams and rivers receiving treated CBM discharge would be reduced. Impacts to air quality, visibility, cultural resources, wildlife, social services, and infrastructure would be the same or similar to those described Alternative B. Impacts to air quality on all reservations would be lower than those discussed under alternative B.

As stated under Alternative B, the timely development of CBM on reservations would reduce the potential for adjacent fluid minerals drainage, but would increase the likelihood of proximity-related impacts to the Absaloka Coal Mine.

Alternative E—Preferred Alternative

The management objectives for Alternative E would result in surface water, groundwater and potential methane drainage impacts similar to those described under Alternative E in the *Hydrology* section. Noteworthy is the fact that the DEQ could set numerical criteria for surface water quality resulting in either restricted discharge to most rivers and streams in the CBM emphasis area or flow based discharge with increased impoundment or discharge with some slight increase to the surface waters SAR, EC, and bicarbonate values. Also noteworthy are the approved Draft Surface Water Quality Standards of the Northern Cheyenne Tribe, which if approved by EPA, could result in restricted discharges in the Tongue River and Rosebud Creek. Regardless of what choice is made, impacts would resemble those described under Alternative E in the *Hydrology* section of this chapter.

There would be no discharge of produced water (treated or untreated) into the watershed unless the operator has an approved National Pollutant Discharge Elimination System (NPDES) permit and can demonstrate in their Water Management Plan how discharge could occur in accordance with water quality laws.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B, however, implementation of the BLM mitigation measures would reduce the likelihood that reservation water resources would be drained from off-reservation CBM activities.

Water quality impacts from infiltration would be minimized as a result of the design and placement of impoundments. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation, and channel stability reducing infiltration impacts to groundwater quality. In addition, impoundments would likely be required to be permitted under the MDEQ General MPDES permit that includes additional conditions to minimize impacts to groundwater (see Hydrology Appendix).

Impacts on Native American hydrocarbons via adjacent production drainage would be similar to those described for Alternative C. As previously mentioned, site-specific conditions control methane liberation and collection and therefore, to evaluate potential drainage, a case-by-case study is necessary. These studies would be required as part of the APD approval process, along with intensified monitoring to determine when and if Tribal CBM resources would be drained. If drainage is likely, the BLM would require the operator to take appropriate action, in consultation with the Tribes, to reduce or eliminate the drainage, or in the case of a federal well, to compensate the Tribe for the loss.

As discussed earlier under Alternative C, the Absaloka Coal Mine could be encroached on by CBM development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe.

As for impacts to air quality, visibility, cultural resources, wildlife, social services, and infrastructure these would be reduced from those described under Alternative B because of the control measures employed with each site-specific Project Plan and the other management features of this alternative discussed in Chapter 2.

Mitigation measures have been developed to protect the Northern Cheyenne Tribal resources, as well as culturally important off-reservation sites. A discussion of these mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to provide the BLM and the Tribe with additional information regarding measures that would be used to protect site-specific resources such as groundwater, CBM, air quality, wildlife, vegetation, and cultural resources.

Conclusion

Impacts from management decisions included in Alternative E, have the potential to result in a slight decrease to surface water quality and a minimal reduction in groundwater availability.

Impacts to the Northern Cheyenne's water right in the Tongue River Reservoir would be as described under Alternative A.

Potential impacts on reservation groundwater drawdown and availability would be mitigated by the implementation of specific BLM control measures. Potential impacts to groundwater would be identified early by the intensified monitoring planned under Alternative E.

Monitoring and drainage analysis would be conducted by the BLM to evaluate the potential for CBM drainage. If monitoring indicated Tribal resources were impacted measures such as production decreases or well shut-in would be instituted, and the appropriate Tribal compensation agreement implemented.

The impacts to lands irrigated by streams and rivers receiving CBM discharge would be minimal as only slight alterations in surface water quality are anticipated.

Impacts to air quality, visibility, cultural resources, wildlife, social services, and infrastructure would be reduced from those described under Alternative B because of the mitigation measures employed with each site specific Project Plan and the other management features of this alternative discussed in Chapter 2. Cultural resources, include important off-reservation hunting, fishing, and plant gathering sites.

Impacts to the Northern Cheyenne Reservation resources would be mitigated by the implementation of control measures described by the BLM in the Northern Cheyenne Mitigation Appendix.

Lands and Realty

Lands and Realty

Emphasis Area Land Ownership:
- Private 65%
- Federal 20%
- Tribal 10%
- State 5%

Total Acreage:
25,551,308

Miles of Road:
- Interstate, 440
- US, 845
- State, 430
- Off-System, 13,550

Miles of Railroad:
- BNSF, 420
- MT Rail Link, 190

Alternative A
No Action (Existing CBM Management)

- Federal:
  - Minimal land area displaced by roads
  - 400 acres disturbed during CBM exploration drilling
- State:
  - Increased motorized access on the CX Ranch.
  - Increase motorized trespass
  - 1,100 acres disturbed during CBM exploration and production activities

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  - Increase fire hazard and motorized access.
  - 25,600 acres disturbed during CBM development activities.
- State:
  - Displace agricultural lands.
  - Disrupt irrigation system, increase cost of farm operation.
  - Reduced property values.
  - Displace community and residential growth.
  - Increase dust and noise impacts on residential use.
  - Increase cost of county road maintenance.
  - Increase long-term motorized access.
  - 29,750 acres disturbed during CBM development activities

Alternative C
Emphasize CBM Development

- All impacts in Alternative B occur in Alternative C in addition to:
  - The land use displacement from roads and utility lines during lease operations is greatest in Alternative C
  - 70,000 acres would be disturbed by CBM activities on private, state and federal lands

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- All impacts in Alternative B occur in Alternative D in addition to:
  - Federal: Permanent loss of land use from road network.

Alternative E
Preferred CBM Development Alternative

- Levels of disturbance would be the same as Alternative B
- Impacts from powerlines, roads, pipelines, and other utilities not requiring transportation corridors would be the same as Alternative C.

Assumptions

Gas from CBM wells is normally measured at the well site or on a collection line before mixing at field compression stations, making it possible for flow lines and compression stations to be shared by different operators to reduce development cost and surface disturbance.

Split estate surface owners have the right to maintain control of non-CBM related access.

Operators are responsible for communicating requirements and stipulations to independent contractors working on behalf of the operator when performing various phases of CBM exploration and production development.

There are no expected disruptions to existing fiber optic, phone, gas, electric, or water lines as a result of the construction, production, or abandonment of project alternatives. It is the responsibility of the operator to identify and avoid buried lines within the pathway of new surface-disturbing activities.

According to the Farmland Protection Policy Act, federal agencies involved in proposed projects that may convert farmland to non-agricultural uses must complete a USDA Farmland Conversion Impact Rating Form AD-1006. The form focuses on two farmland designations: prime farmland and agricultural lands of statewide importance. Prime farmland and agricultural lands designations are based on soil type and productivity and are not based on present use. The AD-1006 form would be completed for each APD application or as part of an Environmental Assessment (EA) checklist to assess impacts to agriculture on federal lands.

No physical displacements of residences or commercial property would result from project alternatives.

CBM-related, human activity increases fire hazards in the project area. The loss of vegetation by fire would impact all land uses including ranching, recreation, and agriculture, and would limit access to public lands because reclamation would be sensitive to soil disturbance.

The required reclamation plan by the operator would be reviewed and approved by BLM on federal lands, by the state on state lands, and by the landowner on private lands.

Impacts From Management Common to All Alternatives

Potential land use impacts would primarily consist of conflicts between conventional oil and gas activities and other uses of property, such as agriculture, residences, and coal mines. New authorizations for major gathering lines, major transportation lines, and power lines, for example, would impact rights-of-way (ROWs) and land segmenting. The development of oil and gas resources impacts agricultural production by taking land out of production and by soil contamination from drilling and production activities.

Surface disturbance associated with oil and gas activities, such as roads, well pads, and battery sites would remove those areas of agricultural production during the life of the road, well pad, or tank battery site. Removal of vegetation would reduce the acreage available for livestock grazing or crop production. Buried flowline and utility line routes would be seeded so the acreage would be temporarily removed from use for grazing or crop production. The infrastructure associated with oil and gas production could affect the movement or area available for livestock and could hinder irrigation systems.

Most existing roads would be lightly traveled by local residents, ranchers, and oil and gas workers. Use of unimproved roads would increase because of daily operations for a month at each site during development and testing of exploration wells. This road activity would be increased in general areas targeted for well development. Unimproved roads would be vulnerable to damage in adverse weather conditions. Public and private lands could be impacted by driving on soft or unstable road surfaces.

Residents and public visitors would be impacted by the sights, sounds, and delays caused by the construction and testing of exploratory and production wells. An increase in slow-moving vehicles would be an impact in areas not currently experiencing these activities. Creation of a temporary, unimproved, unrestricted access road to an area would allow public access and exposure of the property in a new way, and would expand the road system requiring maintenance by federal or state agencies and private landowners.

Public access to most wells would likely be limited because 65 percent of the land area is private; however, there would be conflicts with recreation (see the *Recreation* section of this chapter). Short-term impacts would occur during road building, pad development, drilling, and production-related activities. Access for recreation on legally accessible public lands would increase as a result of the increase in unimproved roads. These impacts would be viewed as a benefit to sportsmen, who generally support increased vehicle access. Road densities on private lands would likely increase in the areas targeted for oil and gas wells, but property owners would be responsible for access control.

CBM development would increase the likelihood of fire because there would be potential incendiary activities occurring where none now occur. Specific causes may include methane leaks, electrical fires from drilling and other construction activities, fires from ruptured gas pipelines, careless smokers, gas migrating from domestic wells contaminated with methane gas, and hot catalytic converters on vehicles.

Produced water of quality suitable for livestock could be placed in impoundments in areas currently without such impoundments for livestock. This would enhance or expand livestock grazing. Construction disturbance would also force cattle onto previously unused range, further changing land use (see discussion on Livestock Grazing). Similar displacement would occur for wildlife, disrupting hunting on land designated for controlled or general hunts.

There may be a trespass impact to private landowners from the conversion of unroaded federal lands with a right-of-way that now allows access to private lands.

On private and public lands, road maintenance would be specified in the lease agreement, drilling permit or Right of Way as the responsibility of either the contractor or landowner.

Complete removal of the indication of vehicle passage and revegetation of two-track exploration on public lands would be important to prevent these temporary roads from becoming an established access through consistent misuse by four-wheel-drive and all-terrain vehicles, especially in areas historically not accessed by vehicles. The Vegetation section describes the seeding policy for reclaiming surface disturbances.

Impacts From Management Specific To Each Alternative

Alternative A—No Action (Existing CBM Management)

Impacts on multiple use of public lands would be minimal because there would be no CBM production development on federal lands. State and private lands would have limited CBM production activities.

Exploration

The amount of new roads to be built would be minimal relative to other alternatives. The primary land use impacts on federal and state lands are from short-term direct land use displacement by exploratory well pads and the creation of two-track trails across prairie or other lands from exploratory equipment. Impacts on private lands would be largely addressed in the contractual agreement with the private owners of the CX ranch.

Production

Newly created roads for CBM production would increase access across the CX Ranch that may displace or change the land use patterns on the land.

Abandonment

Two-track trails and associated motorized access created by CBM exploration on federal and state lands would be reclaimed after abandonment, unless otherwise authorized. New access created under a ROW may be reclaimed depending on the situation and the BLM and surface owner's requirements. New motorized access in watersheds targeted for water quality restoration by MDEQ may require road reclamation as part of abandonment. Reclamation based on water quality would be on a case-by-case basis with involvement from MDEQ. Abandonment and reclamation of roads on the CX Ranch could be highly variable according to the agreement with the surface owner. Abandonment impacts on private land cannot be determined because of its variability, but private landowners would be able to negotiate reclamation agreements to avoid long-term impacts to their land. Unwanted roads on the CX Ranch would be obliterated and revegetated according to the agreement with the lease operator.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative A. If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts to the reservation. Trespassing from CBM related vehicles might increase because of activities adjacent to the reservation. Traffic is also expected to increase on reservation roads.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Traffic is also expected to increase on reservation roads.

Conclusion

Alternative A would have the least land use impact among alternatives because of the limited number of exploration and production wells within the project area. The greatest potential land use impact would be the ranching disturbance and displacement on the CX Ranch (see the *Livestock Grazing* section of this chapter). Approximately 500 acres of surface area would be disturbed, which is less than 0.01 percent of the total RMP areas and Park, Blaine, and Gallatin Counties.

Cumulative impacts are estimated to be approximately 37,470 acres of disturbance. In addition to CBM related activities, includes impacts associated with conventional oil and gas, active coal mines, fires, highway projects, and power plants. The cumulative impacts comprise 0.15 percent of the entire emphasis area.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Exploration And Production

Short-term impacts of land uses during construction would consist of the physical intrusion by CBM crews and equipment, the local generation of dust and noise, and the limited obstruction of traffic. Long-term impacts include loss of existing land use, increased access from roads, and loss of land value.

Some surface landowners are unaware of the severed mineral rights, and even though compensated, would be displeased with the possibility of having well facilities located near dwellings. There are no legally required buffer distances between CBM facilities and residential, community, or government dwellings. Placement of roads and well pads near residential, business, and community dwellings may cause direct reduction of property values.

Although there may be no statute that covers buffer distances, State of Montana oil and gas leases include a minimum buffer distance of 200 feet. Reasonable additional buffers can be added as needed at the time of site-specific operating plan review, including movement up to 656 feet on Federal leases.

Impacts from placement of roads, utility lines, pipelines, and well pads around communities may cause loss of future community development opportunities. These uses displace other surface uses like residential development and location of public parks and schools. There are safety and liability concerns.

Although private landowners and state land managing agencies would help decide road routes on their lands, as described in the Mitigation section, they would likely want to maintain some roads that benefit existing or future uses.

The increase in average daily traffic (ADT) of U.S., interstate, and state highways by action alternatives would be minor and is not expected to decrease their designed level of service within the CBM project area. Increased highway ADT over the 20-year life of the project would be largely from increases in demographics.

County roads in some portions of the project area would receive substantial CBM exploration and development traffic volumes. This large influx of CBM-related traffic on some isolated county and local roads would increase their associated road maintenance cost.

Lease operators would discuss compensation with county and local road and bridge departments when CBM-related traffic has caused increased road maintenance cost. There may be times when an operator or a group of operators may choose to provide maintenance for a particular road.

Short-term exploration impacts to farming include seasonal loss of crops during construction, interference with irrigation patterns, and increased introduction of noxious weeds.

Cropland area converted to production well pads and roads would be lost for the up to 20-year life of the project. Based on estimates in the Vegetation section, 20 percent of wells on state-permitted land in Blaine, Gallatin, and Park counties would occur in cropland soils. Four percent of wells in the Powder River RMP area and 8 percent of the wells in the Billings RMP area would occur in cropland soils. Specific long-term impacts include land displacement; alteration of existing flood and center pivot irrigation systems; modification of farming operations near and around well pads and access roads; potential for proliferation of noxious weeds; surface and groundwater quality losses; farming operations that are no longer commercially viable at certain locations; economic losses associated with all of the above; and lower land values.

Direct impacts on commercial woodlands would be caused by the immediate harvest of timber in ROWs and well pad sites and the loss of timber growth in these areas during the life of production and time of regrowth to merchantable trees. The income loss for the tree growth loss is reflective of time to grow merchantable trees, which is 50 to 100 years after reclamation of ROWs and pad sites. New roads on public forest lands may become part of the existing road system and their ROWs would be a permanent loss of timber production. The increased use of four-wheel-drive and all-terrain vehicles would allow other vehicles to have extensive access once a route is established.

Roads from CBM development and CBM-related motorized activity may create conflict with timber cruising, logging, and hauling activities of an active timber sale. CBM-related traffic could increase traffic hazards with log-hauling trucks unless road use coordination occurs.

Indirect impacts from land clearing include wood fuel loading, introduction of noxious weeds; increases in insect population from slash buildup; and increased access for forest and fire management. CBM-constructed roads may not always be located in the best area for managing forest resources.

Abandonment

On federal and state lands, the access plan would create fewer two-track trails and roads than other development alternatives. Utility reclamation would occur with road reclamation because they are located in the same corridor. Public access would be restricted over the life of the CBM productions on the road network, and would not become part of the permanent public access network. On private lands, road abandonment would be highly variable because each landowner agreement could be different.

Regeneration time of timber to commercial size after CBM activities or other related land use would likely be 50 to 100 years. Road obliteration would include re-contouring the landscape and planting tree seedlings appropriate to the forest site.

Damage from a fire related to CBM activities would be the responsibility of the operator. Liability of fire is detailed in Statute 50-63-103 Montana Code Annotated (MCA).

Crow Reservation

If there were no CBM development on Tribal Lands, then impacts on the reservation, other than CBM related traffic discussed above, would be minimal.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative B.

Conclusion

Alternative B would have the least impact to present land use of the four development alternatives (B, C, D, and E). For example, the required use of a transportation corridor for both road and utility lines in a one-way pattern reduces the direct surface disturbance by an estimated one-third compared to a grid pattern, multiple corridor approach.

Common land use impacts from roads, pads, pipelines, and utility lines include direct loss of agriculture, timber, grazing, recreation, and wildlife habitat and increased potential of wildfire. Indirect impacts include limited road access; dust, noise, and reduced property values; and increased local road maintenance cost, production, water storage, and ground injection, which reduces the potential direct and indirect impacts to other surface land uses. Residual benefits of the road networks created for CBM development include increased access for fighting fires and create fuel breaks.

Most direct and indirect impacts are mitigated through reclamation and financial compensation. Although minimal impacts due to dust may occur dust abatement measures would be actively employed to minimize impacts to air quality as well as land resources. Surface owner agreements would be used to prevent avoidable impacts to residents and communities. Impacts minimized by surface owner agreements include but are not limited to disruption to irrigation facilities, placement of roads, pipelines, and well pads. Unmitigated impacts include displaced, non-monetary uses like public access, fire hazards, and noise disturbance to livestock Alternative B is estimated to cause 32,940 acres of surface disturbance, which is less than one percent of the total RMP areas and Park, Blaine, and Gallatin Counties.

Cumulative impacts for Alternative B include increased fire hazards from CBM exploration and development, which are the largest potential cumulative economic and environmental impacts to future land uses. The loss of range, timber, habitat, dwellings, access, and other impacts would not be recovered for a long time. However cumulative impacts are estimated to be 84,670 acres which is less than 1 percent of the entire emphasis area.

Alternative C—Emphasize CBM Development

The less stringent access plan, separate placement of pipelines, utility lines, lack of buffers, and use of production water, would lead to an increase in surface land disturbance when compared to the other alternatives.

Exploration And Production

New production roads may be placed along existing trails or be placed in the more traditional road grid system, which allows multiple routes from any production intersection. The traditional road grid system used for CBM production would create the highest density of roads and may increase the size of the public road network. On private lands, road placement would be a contractual agreement with the surface owner and roads may be left in place or reclaimed.

Surface disturbance from roads, pipelines, and utility lines is estimated to be approximately 30 percent greater than Alternatives B and D (see Table 2-2 in Chapter 2) because there are not the same road and utility restrictions to this alternative. Surface disturbance and its impact to agriculture is similar to Alternative B because most agriculture is on private lands. The potential impacts from production water discharges are also similar for the same reason.

CBM production water may have high levels of salinity or sodicity, which can cause negative impacts to agriculture with continued use. The saline level of the average CBM production water is near the threshold for causing yield reduction. Reduction in yields would be expected in salinity-sensitive crops like alfalfa, corn, and clover hay. High SAR production water would reduce water infiltration, especially in clay soils, and would increase erosion.

CBM water with combined high SAR and low EC can cause notable reductions in the water infiltration rate of irrigated crops (ALL 2001b). Repeated sprinkler-applied CBM water high in saline can cause salt accumulation near the soil surface and cause foliar damage to certain crops. Dewatering coal seams may lead to release of methane gas that can contaminate neighboring agricultural and residential wells (ALL 2001b). The contamination of wells is a possibility that cannot be estimated in either amount of methane per well or by proximity of a well to a CBM field. Any contaminated well could be rendered unusable, and if the well is within a closed structure, increased ventilation is required to reduce buildup to explosive quantities.

It must be assumed that the historic road grid system used for CBM development is a worst-case scenario allowed under this alternative when there are no existing disturbances. The road grid system would create the densest road network and largest surface disturbance by providing multiple access to all the wells in the 80-acre well spacing proposal.

Abandonment

Land use displacement from road disturbances would be an assumed 20-year loss on federal, state, and private lands as in Alternative B, except there is more displacement on federal and state lands with this alternative. Land use displacement on private lands would have varying degrees of reclamation based on whether road placements benefit long-term private operations.

There is limited access to many small federal land parcels within the project area. CBM lease operators would create roads to these parcels and increase access and potential public use of the federal parcels. Neighboring private owners who have contributed access to the federal and state parcels may incur increased trespass problems similar to Alternatives B and D.

Crow Reservation

If there were no CBM development on Tribal Lands, then impacts on the reservation, other than increased CBM related trespass problems discussed above, would be minimal.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative C.

Conclusion

CBM management under Alternative C would result in the most impacts to present land uses among the four development alternatives (B, C, D and E). The disturbance is estimated to be one-third greater than Alternatives B and D. The two main causes for the increased surface disturbance and land use displacement are from use of a traditional road grid system. Surface owner agreements would be used to minimize surface disturbance due to road placement.

Overall approximately 47,598 acres of surface on private lands would be impacted, even with the increased impacts this area is less than one percent of the RMP areas and Park, Blaine, and Gallatin Counties. Cumulative impacts including the additional surface impacts total 105,897 acres for Alternative C. The increased cumulative impacts remain below 1 percent of the entire emphasis area.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Short-term transportation impacts on federal and state land uses would be the same as Alternative B. However, the long-term transportation impacts would be greatest because road obliteration and reclamation might not occur under this alternative and would permanently displace present and future land uses. The roads would become part of the public transportation system and would increase vehicle access on federal lands. The existing public road network may receive substantial traffic during production, requiring increased maintenance cost by public agencies. The new roads on federal lands that are not reclaimed would become the maintenance responsibility of the corresponding public agency.

Crow Reservation

Impacts on the Crow Reservation would be primarily the result of vehicle trespassing.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative D.

Conclusion

Alternative D has the same short-term transportation impacts as Alternative B but has the greatest long-term land use displacement impacts from the created permanent roads. The types of land use displacement with this alternative are the same as other development alternatives. Surface owner agreements would be used to minimize impacts due to land use displacement.

Most direct and indirect impacts are mitigated through reclamation and financial compensation. Unmitigated impacts include public access, fire hazards, and disturbance to livestock. Total permanent surface impacts and cumulative impacts are estimated to be the same as alternative B.

Alternative E—Preferred Alternative

Exploration and Production

The type of impacts from roads, pipelines, and utility lines in Alternative E are the same as those described in Alternative B. The extent of these impacts would be the same as described in Alternative C. This alternative, like Alternative C, would not require transportation corridors for the placement of roads, utility lines, and pipelines. Existing disturbances would be used as much as possible for utility access. Management features of Alternative E include burying power lines in certain locations and requirements of a project plan to minimize impacts.

Land use displacement from road disturbances would be up to 20-years on federal, state, and private lands as with Alternatives B and C. CBM lease operators would create roads to small federal and state parcels never before road accessible to the public. Motorized trespass would be enhanced as a result of the increased road network on federal, state, and private lands from CBM-related exploration and development.

Agricultural-related impacts would be the same as those described in Alternative B.

CBM activities increases the likelihood of fire. Road networks created for CBM development would increase access for fighting fires.

Abandonment

Abandonment of roads, utility lines, and powerlines would be the same as described in Alternative C.

On private lands, road abandonment would be highly variable as with the other alternatives because each landowner agreement would be different.

Liability of fire is detailed in Statute 50-63-103 Montana Code Annotated.

Conclusion

CBM operators would be required to submit a Project Plan when the proposed development for an area would exceed one well per 640 acres.

The type of impacts from roads, pipeline, and utility line in Alternative E are the same as those described in Alternative B. The extent of impacts would be the same as described in Alternative C. This alternative, like Alternative C, would not require transportation corridors for the placement or roads, utility lines, and pipelines. Existing disturbances would be used as much as possible.

New roads would remain open or closed at the surface owner's discretion. Roads would be reclaimed upon abandonment.

There would be no degradation of watersheds from release of production water. A Water Management Plan would be required for every exploration Permit to Drill. First priority for discharged water would be for beneficial uses.

The potential for fire hazard is the same as Alternatives B, C, and D. Surface disturbances associated with Alternative E would impact approximately 44,040 acres. This is equivalent to less than one percent of the combined area of the RMP areas and of Park, Blaine, and Gallatin Counties. The total area of cumulative impacts, including surface disturbances from additional activities described previously, are estimated to be 95,770 acres. This total area is less than 1 percent of the entire emphasis area.

Livestock Grazing

Livestock Grazing

AUM is equal to the amount of forage required to support one cow and her calf or 5 sheep for one month.

The CBM Emphasis area has an estimated 1,207,400 acres of classified grazing and forested lands capable of supporting 323,941 AUMs.

Alternative A
No Action (Existing CBM Management)

- Exploration wells located within BLM-permitted rangelands would result in the temporary loss of 69 AUMs
- State:
  - The exploration wells and production wells located at CX Ranch would result in a maximum construction loss of 272 AUMs on state and private rangelands.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Exploration wells would result in the temporary loss of 413 AUMs (BLM 163, State 250).
- Production wells would result in a maximum construction loss of 11,960 AUMs (BLM 4,770, State 7,190).

Alternative C
Emphasize CBM Development

- Impacts to livestock grazing would be similar to but slightly greater than those in Alternative B due to the discharge of untreated production water on to the ground resulting in increased erosion
- CBM discharge water could be used for livestock watering.
- Increased erosion could result in increased surface disturbance, which could lead to disrupted grazing patterns, undermined fencing, and reduced forage.
- A decrease in forage could occur if discharged produced water is too high in saline content; and possible effects to livestock if produced water is to unsuitable quality for stock watering.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Impacts would be similar to Alternative B with some exceptions: disturbed acreage would increase due to the piping of discharge water to the nearest disposal point. There would be less forage losses than A.H.B.

Alternative E
Preferred CBM Development Alternative

- Impacts to livestock grazing would be similar to Alternative B.
- Suitable CBM discharge water could be used for livestock watering.
- Land application of produced water would promote growth of vegetation.

Livestock grazing and petroleum development would be generally compatible because exploration activity would be temporary and operational activities require a small area for equipment. Livestock grazing on rangeland would continue during CBM and conventional oil and gas development.

Assumptions

Affected acres and animal unit months (AUMs) were calculated assuming all CBM activity would be located on grazing lands. AUM losses were predicted separately for the two BLM RMPs and the state because of differences in permits and land grazing capacities. The analysis is focused on the CBM emphasis area, but applies to similar areas throughout Montana. It is assumed that existing roads and fence crossings would be used for oil and gas operations as much as possible.

Impacts From Management Common to All Alternatives

Impacts on rangeland would occur from the loss of vegetation for livestock grazing; the disruption to livestock management practices; and loss of grazing capacity from construction of well pads and roads. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. With the exception of minimal short-term forage loss, these impacts would only last as long as construction activities were ongoing. Controlling livestock movement by maintaining fence line integrity would be used to preserve efficient livestock and range management. The construction of roads and pipelines would bisect fences, which would require placement and maintenance of cattle guards and gates. The current development of oil and gas and CBM on state land would require installation of cattle guards on fence lines to prevent livestock escape. The impacts of oil and gas development would result in the loss of about 833 AUMs in the Billings RMP, 830 AUMs in the Powder River RMP, and 359 AUMs on state-permitted rangelands. These losses would be reduced to a total of 735 AUMs during the production phase of oil and gas activities.

While roads, trails, and well pads would block traditional cattle trails, this network of new roads would provide livestock producers with improved access to remote livestock facilities and grazing areas. However, road systems would interfere with livestock dispersal and cause decreased forage efficiency because cattle tend to congregate and travel along roads. The relatively high volumes of exploration vehicle traffic would present a hazard to livestock.

Heavy traffic on temporary access roads would increase the risk of collision with stock, resulting in injury or death of the animals. Airborne dust stirred up by heavy exploration vehicles would settle on forage along the road. The dust would affect the palatability of grass and forbs up to 1/4 mile from the road. Livestock forage could be killed by accidental spills of crude oil, high saline-produced water, or drilling fluid.

Areas of soil disturbance, such as results from construction, may experience an influx of noxious weeds. Noxious weeds reduce rangeland value to livestock by displacing preferred forage species. Severe infestations would result if weeds are not controlled, decreasing rangeland capacity for grazing. Additionally, some weed species are poisonous to livestock, causing illness, internal injury, or death when ingested.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Exploration wells located on BLM-permitted rangelands would result in the temporary loss of 30 AUMs for the Billings RMP rangeland and 39 AUMs for the Powder River RMP rangeland. There would be no production activities in BLM planning areas under this alternative and, therefore, no impacts from production. State-permitted exploration and production wells located at CX Ranch would result in a loss of 272 AUMs. Revegetating parts of the well pads during production would reduce the losses to 194 AUMs.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative A. If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBM development on the reservation, then reductions in AUMs could be occur.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation.

Conclusion

During the next 20 years, disturbances from CBM development, conventional oil and gas development, and other projects considered under the cumulative effects analysis would result in the loss of about 863 AUMs in the Billings RMP, 869 AUMs in the Powder River RMP, and 955 AUMs on state-permitted and private rangelands. These losses would be reduced to a total of 929 AUMs during the production phase of CBM and conventional oil and gas activities. After CBM production ceases, the lands would be reclaimed. Revegetated areas would be available for livestock grazing.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Alternative B considers expanded development of CBM resources. Table 4-47 presents the predicted AUMs that would be lost from exploration, construction, and production on both BLM and state grazing lands. Losses from exploration would be mostly temporary (less than 5 years) and would be reclaimed after exploration activities cease. Revegetating parts of the well pads during production would be used to reduce construction losses to those shown below under operation losses.

Impacts on livestock grazing would be reduced under this alternative through the requirement of transportation corridors, using multiple completions per well bore and directional drilling, injecting produced water instead of storing on-site in impoundments, and rehabilitating new roads at the end of the well lifetime. All of these would help to minimize the area of surface disturbances shown in Table 4-47 by up to 35 percent during construction and 40 percent during production, thus reducing the number of AUMs lost.

Crow Reservation

If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBM development on the reservation, then reductions in AUMs would occur.

TABLE 4-47
NUMBER OF PREDICTED ANIMAL UNIT MONTHS (AUMS) LOST TO EXPLORATION, CONSTRUCTION, AND PRODUCTION

	AUMs Lost to Exploration	AUMs Lost to Construction	AUMs Lost to Operation
Billings RMP	11	340	209
Powder River RMP	152	4,430	2,275
BLM Sub-total	163	4,770	2,484
State/Private Lands	250	7,190	4,420
Total	**413**	**11,960**	**6,904**

Northern Cheyenne Reservation

If there were no CBM development on Tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBM development on the reservation, then reductions in AUMs would occur.

Conclusion

During the next 20 years, disturbances from CBM development on state, BLM, Native American, and USFS lands; along with the cumulative effects of other projects would result in the loss of about 18,500 AUMs. These AUM losses would be partially recovered during the production phase of CBM and oil and gas activities, and after production ceases and the lands are reclaimed. The requirement for transportation corridors, injection of produced water (less land needed for impoundments), and multiple use of drilling pads would help to minimize livestock grazing losses up to 35 or 40 percent.

Alternative C—Emphasize CBM Development

Impacts on livestock grazing would be similar to Alternative B with the following exceptions: transportation corridors and collocation of wells would not be required, thereby increasing the number of disturbed acres and AUMs lost compared to Alternative B (see Table 4-47); suitable CBM discharge water could be used for livestock watering reducing the amount discharged; and the discharge of produced water to the surface would increase erosion and cause increased surface disturbance to livestock. Other impacts would include the possibility of an increase of noxious weeds and a decrease in forage material if produced water that is too high in saline content is discharged on the land surface, and possible health effects if livestock consume produced water that is unacceptable (ALL 2001b). Generally, water is acceptable for livestock if the TDS is lower than 10,000 mg/l and the EC is less than 16,000 µS/cm. Some CBM water has also been found to exceed standards for fluoride (2 mg/l) and aluminum (0.2 mg/l) (ALL 2001b). Discharging untreated CBM-produced water on the ground surface at the well pad would lead to increased localized soil erosion and gullying, which could also lead to disrupted grazing patterns, undermined fencing, and reduced forage.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices. The discharge of untreated CBM production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies, fence post disturbance, and limited vegetation loss.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices. The discharge of untreated CBM production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies, fence post disturbance, and limited vegetation loss.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance could be greater since transportation corridors and collocated wells are not required. Surface discharge of untreated produced water could result in increased forage loss, erosion, gullying, grazing pattern disruptions, and fencing undermining. Forage losses could be permanent because of soil sterilization by saline water applications. This amount would vary depending on the quality and quantity of water discharged. Watering livestock represents only a small portion of the estimated 20 percent beneficial reuse assumed under this alternative, but would still result in a small amount of impacts reduction to the other resources.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on livestock grazing would be similar to Alternative C with the following exceptions: impacts from drilling and collocation of wells would be the same as Alternative B; transportation corridor and road impacts would be similar to Alternative B; discharged CBM-produced water would be treated and not discharged directly at the well site; and there would be a reduction to forage losses from increased land application of produced water through irrigation applications. This would be a favorable impact from having more treated water available in the winter and arid months available for livestock watering and irrigation of grazing lands. Mitigation measures would be similar to Alternative B.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Conclusion

Cumulative impacts would be similar to Alternative C with some exceptions: impacts from drilling and co-location of wells would be the same as Alternative B; transportation corridor and road impacts would be similar to Alternative B; there would be a reduction to forage losses from increased land application of produced water; and there would be less soil and forage loss from erosion of soils.

Alternative E—Preferred Alternative

Impacts on livestock grazing would be similar to Alternative B with the following exceptions: transportation corridors and co-location of wells would not be required, thereby increasing the number of disturbed acres and AUMs lost compared to Alternative B (see Table 4-47); suitable CBM discharge water could be used for livestock watering reducing the amount discharged; Water Management Plans would be designed on a site-specific basis so no degradation would occur to water quality or to beneficial use. Such uses could include livestock watering and irrigation (benefits for livestock). Mitigation measures would be similar to Alternative B.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance could be greater since transportation corridors and co-located wells are not required. There would be less soil and forage loss from erosion of soils. Beneficial use of produced water by watering livestock would reduce, by a small amount, the impacts to other resources.

Paleontological Resources

Paleontological Resources

Paleontological resources consist of fossil-bearing rock formations that underlie the entire planning area. Fossil outcrops are relatively rare throughout the emphasis area, but know areas are protected.

Alternative A
No Action (Existing CBM Management)

- It is unlikely that any of the 1,500 acres disturbed during CBM development activities would contain noteworthy paleontological resources. The 575-acre Bridger Fossil Area ACEC (only paleontological resource) would not be disturbed.

Alternatives B, C, D, and E

- Impacts would be nearly the same based on level of disturbance, know locations of rich fossil areas and distription of geological formations with paleontological resources.
- There would be between 55,400 and 74,000 short term acres disturbed during CBM development activities increasing the chances that a minor fossil discovery would be made. Cumulative impacts would disturb an additional 33,400 acres increasing the likelihood of additional fossil discoveries.

Assumptions

Surface occupancy is prohibited within designated paleontological sites on BLM minerals in the planning area. A modification or waiver may be applied for as mentioned for the Cultural Resource section. Provided the paleontological resource values can be protected or undesirable impacts mitigated, the exception would be granted.

Impacts From Management Common to All Alternatives

Impacts would occur if paleontological resources were encountered unexpectedly during surface disturbance activities.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Impacts from this alternative would be similar to those described in the *Impacts From Management Common to All Alternatives* section above, with some exceptions. In CBM development there would be no geophysical exploration that could result in the destruction of paleontological resources. Other impacts would include vandalism and removal of fossils by fossil collectors resulting from increased accessibility to remote areas.

Crow Reservation

There would not be impacts to paleontological resources on the Crow Reservation from off-reservation CBM development.

Northern Cheyenne Reservation

There would not be impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBM development.

Conclusion

Cumulative impacts would include the effects from CBM development, conventional oil and gas development, and surface coal mining activities. Known paleontological resources within the planning area would be protected by Section 6 of the lease terms. NSO stipulations applied to known paleontological resources would help protect those sites.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Impacts from Alternative B would be similar to Alternative A, with some exceptions. Development could result in increased access to remote areas. The impacts of increased access could include vandalism or removal of fossils by fossil hunters.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBM development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBM development.

Conclusion

Cumulative impacts under this alternative would include increased CBM development and a potential increase in vandalism or removal of fossils.

With the development of Tribal CBM resources, it is anticipated that some reservation sites would be encountered that may contain important paleontological resources. As the Tribes develop their own CBM resources, it is anticipated that Tribal monitors would oversee all surface disturbing activities and, therefore, all significant paleontological resources would be protected.

Alternative C—Emphasize CBM Development

Impacts would be similar to Alternative B with some exceptions. Under this alternative, surface disturbances from ROWs would result in impacts on paleontological resources and increased access to remote areas. The impacts of increased access could include increased vandalism and removal of fossils by fossil hunters.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBM development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBM development.

Conclusion

Cumulative impacts would be similar to Alternative B with increased surface disturbance from the lack of ROWs, potential vandalism or removal of fossils because of increased access to remote areas.

The use of Tribal monitors overseeing surface disturbing activities on the reservations during Tribal CBM development would prevent most impacts from occurring to paleontological resources.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts would be the same as described under Alternative B.

Alternative E—Preferred Alternative

Impacts would be similar to Alternative C with some exceptions. Under this alternative, the project plan stipulations could decrease the amount of surface disturbance. Directional drilling may be performed on deeper coal seams and would decrease surface disturbances. The potential for impacts from surface disturbances resulting from the placement of underground utilities would increase impacts to paleontological resources. Where significant paleontological resources are suspected, the operator's plan will include a paleontological component that will address data collection and evaluation methods if paleontological remains are encountered.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBM development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBM development.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative C with the exception of the potential for less surface disturbances The impacts to paleontological resources would be minimized.

The use of Tribal monitors overseeing all land disturbing activities on the reservations during Tribal CBM development would prevent most impacts from occurring to paleontological resources.

Recreation

Recreation
Montana's natural features offer a variety of year-round recreational opportunities

Alternative A
No Action (Existing CBM Management)

- Minor loss of land for recreation purposes, and the disruption to recreation activities
- Exploratory activities such as drilling and testing could temporarily displace game species locally

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Moderate loss of land for recreation purposes and the disruption to recreational activities
- Increased opportunities for access to remote areas

Alternative C
Emphasize CBM Development

- Impacts would be similar to Alternative B with the exception that increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Impacts would be similar to Alternative B.

Alternative E
Preferred CBM Development Alternative

- Impacts would be similar to Alternative B.

Assumptions

Recreation uses and areas are described in Chapter 3. Most of the recreation resources in the study area consist of dispersed activities such as hunting and fishing. BLM stipulations would be applied. Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. In general, the demand for recreational activities would increase proportionately with the increase or decline of regional populations.

Impacts From Management Common to All Alternatives

Recreation areas are potentially impacted by surface-disturbing activities. The activities that involve the use of heavy equipment (road construction, well drilling, pad construction, pipeline and utility placement, etc.) would result in changes to the natural landscape, which would cause the most surface disturbance and have the greatest impact on recreation areas. Other activities, such as increased travel and vandalism resulting from access improvements, and increased erosion from surface disturbances, can also impact recreation areas. These activities can produce indirect impacts to recreation areas such as fires, hazardous waste spills and cleanups, changes in livestock grazing patterns, and changes in wildlife habitats.

BLM has stipulations to protect developed recreation areas and undeveloped recreation areas receiving concentrated public use The state also has stipulations for protection of recreation areas including prohibiting activity within 100 feet of streams, ponds, lakes, or other water facilities. Additional state stipulations include a 1/8-mile buffer for rivers, lakes, or reservoirs, and a sensitive areas stipulation that may be used when field staff receive comments regarding recreation areas. Most of the recreation resources in the study area are dispersed activities, such as hunting and fishing, and are not developed recreation sites. Exploratory activities such as drilling and testing would temporarily displace game species locally. Installation of oil and gas production facilities in areas used for hunting, hiking, and other dispersed recreational activities would infringe on the solitude and rural characteristics of the area. The oil and gas infrastructure and activities would reduce the number of game animals in the area or force some game animals to leave the area which would reduce or eliminate certain hunting activities. Hunters would be concerned about shooting around facilities and equipment.

Exploration and production would create new roads that would provide easier motorized access to areas that may not have been accessible before. Motorized recreation user groups would see this as a benefit to their sports, and would appreciate increased access to streams, lakes, and hunting areas. Non-motorized recreational enthusiasts who seek solitude and quiet, including backpackers, hikers, and some hunters and anglers, would not benefit from road development. As formerly remote areas become more accessible and competition for limited resource escalates, conflicts among these user groups would occur.

Increased human access and increased human activity associated with exploration and development would result in increased legal and possibly illegal harvest of fish from nearby drainages. Increased legal harvest would be a recreation benefit as fishing opportunities are more accessible to a wider range of people and game regulations are adapted to accommodate the increased fishing pressure. However, if increased illegal harvest causes fish populations to drop below a sustainable level, fishing as a recreational resource could be affected.

Increased access typically causes an increase in vandalism and the need for law enforcement. As recreation in public lands becomes more popular, undeveloped recreation sites would generally require more time and attention and have the potential to become developed sites, if use becomes concentrated to that level. Exploration and production activities may cause some ranches to be closed to hunting access via surface agreements.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Construction of roads, well pads and facility sites in designated recreation areas or immediately adjacent to them would detract from the quality of the recreation areas and diminish the quality of the recreational experience. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally. Since there would be no production activities in BLM planning areas under this alternative, there would not be any impacts from production on BLM land.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for recreation in general. If there were no CBM development on Tribal Lands, then there would be minimal impacts on recreation on the reservation. Impacts to hunting and fishing from trespassing could impact Native Americans who rely on these resources for subsistence purposes.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusion

Cumulative impacts would include the effects of Alternative A combined with conventional oil and gas development and other projects discussed in the Minerals Appendix. These would include impacts from nearby activities such as mining or power generation facilities, which can result in increased use due to increases in population associated with additional available jobs. (Note: surface mining is preparing to expand by 4,000 acres under permit request now. See this chapter's *Introduction* section.)

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Alternative B would allow development with single-lane roads and turnouts. Upon abandonment, new roads would be rehabilitated and closed. Impacts from this alternative would be similar to Alternative A with the addition of increased CBM development resulting in increased access, resulting in increased impacts on dispersed recreation activities such as hunting and fishing.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impact of this alternative is increased CBM development, which could result in increased access to remote areas and increased vandalism.

Cumulative impacts under this alternative would be greater than those described under Alternative A.

Alternative C—Emphasize CBM Development

Impacts on recreation areas would be similar to Alternative B, but an increased number of disturbed acres and opportunities for access. Discharge of produced water directly to the ground could increase erosion. Increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting. The discharge of untreated CBM production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies and limited vegetation loss that could further alter wildlife habitat and change hunting opportunities.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting. The discharge of untreated CBM production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies and limited vegetation loss that could further alter wildlife habitat and change hunting opportunities.

Conclusion

The residual impacts of this alternative are similar to Alternative B. The greater surface disturbance from roads could increase the opportunity for access to remote areas. The discharge of water could increase erosion and damage lands used for recreation.

Cumulative impacts would be greater than those described under Alternative B, but on a large scale because of the emphasis on CBM development.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on recreation resources would be similar to Alternative B, but less because of water management measures to eliminate soil erosion by piping discharged water to the nearest body of water.

New oil and gas roads would remain open or closed at the surface owner's discretion. Open roads would create impacts; closed roads would prevent impacts.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impacts of this alternative would be similar to those described under Alternative B. Cumulative impacts would be greater than those described under Alternative A because of the expanded CBM development.

Alternative E—Preferred Alternative

Alternative E, the Preferred Alternative, would allow CBM development subject to existing planning restrictions and balances CBM development and the protection of the natural environment. Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally. Impacts from surface disturbance would be minimized by using existing disturbances where possible. Because transportation corridors are not required, the number of disturbed acres and opportunities for access would be greater than Alternative B.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impacts of this alternative are similar to Alternative B. Surface disturbance from roads would be greater than Alternative B, increasing the opportunity for access to remote areas.

Cumulative impacts would be similar to those described under Alternative B.

Social and Economic Values

Social and Economic Values
Socio-economics address the changes in demographics; social organization including housing attitudes, and lifestyles; economics such as employment, unemployment and per capita income; and, government revenue sources including taxes, state oil and gas lease income, federal mineral revenues and private landowner revenues.

Alternative A
No Action (Existing CBM Management)

- No social impacts (only small changes in employment, population, demand for services, etc.).
- Small impact on economic conditions as a result of new production wells.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Social impacts would include new jobs and new population moving to the area.
- Economic impacts include generation of new personal and government income.
- Additional disposal costs associated with injection of producted water.
- Additional demands on public services.

Alternative C
Emphasize CBM Development

- Social impacts same as Alternative B. Increase in impacts on lifestyles and values.
- Economic impacts same as Alternative B. Increase in impacts to water resource users.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Social impacts same as Alternative B. Small increase in impacts on lifestyles and values.
- Economic impacts same as Alternative B. Small increase in impacts to water resource users.

Alternative E
Preferred CBM Development Alternative

- Social impacts same as Alternative B. Public burden to maintain roads may increase depending on landowner access decisions.
- Economic impacts same as Alternative B, except that oil and gas income may be less depending on water treatment costs.

Assumptions

It is assumed that the average CBM production well in Montana produces about 125,000 cubic feet per day (MBOGC 2001a). Using a gas price of about $4.00 per thousand cubic feet, the average well would generate about $182,500 per year in total income. Income-producing wells on average are expected to last between 10 and 20 years, with an average production life of 15 years. Exploration wells do not produce income.

The social and economic analysis in this chapter is based on the RFD rate of development over a 20-year period. During this 20-year period, all CBM wells would be drilled and production would peak. However, because CBM wells typically produce for 10 to 20 years, a well drilled in year 20 would continue to produce until year 40. Thus, social and economic consequences of production and abandonment would continue for up to 20 more years beyond the period assessed here.

The number and type of jobs related to CBM development would vary with the project phase, exploration, development, production, or abandonment. During exploration and development, the majority of jobs created would be for well drillers and pipeline installers along with specialty positions such as land surveyors, supervisors, and geologists. A number of related support personnel (e.g., truck drivers and material handlers) would also be required during these activities. During production, most new jobs would be for maintenance and repair workers and their supervisors. During abandonment, field workers, support workers, and their supervisors would be in demand.

To simplify this analysis, all dollar amounts (e.g., wages and other project-related income) are reported in current dollars with no adjustment for inflation over time.

Impacts From Management Common to All Alternatives

Impacts on social conditions would include changes in employment and population; changes in the services provided by governments; the effects of drilling and related activities on rural lifestyles in the project area; the effects of changes in employment opportunities on communities; changes in levels of traffic, noise, visual resource impacts, and psychological stress levels; and the effects of population change on local housing, schools, and services.

The information reflected in the public comments and newspaper reports summarized in Chapter 3 indicate a range of attitudes and beliefs with respect to the development of CBM and its relationship to the lifestyles and values of area residents.

As discussed in Chapter 3, the majority of public comments received during scoping related to concerns about impacts on the environment, and water quality and quantity in particular. The possibility of unfavorable economic impacts resulting from environmental impacts is also a concern. Other concerns include possible increases in traffic levels, noise, visual resource impacts, and psychological stress associated with changes to the surrounding built and natural environment.

Numerous social and cultural impacts have been predicted by Native Americans as a result of CBM development on adjacent fee, state and federal minerals. These potential impacts include: the lack of access to energy-related employment, population influx, over-commitment of Tribal revenue, abridged effectiveness of Tribal governments, stressed infrastructure and service related capacity, altered social organization and social well being perception, and the further influence of western culture resulting in changes to traditional beliefs and value systems.

Direct economic impacts of the project would include changes in personal income resulting from new employment of oil and gas workers; purchases of services from local area vendors; lease, royalty, and production payments; taxes and other government levies; impacts resulting from changes in environmental quality; and related changes in the fiscal health of county, state, and federal governments. Indirect impacts would include induced economic activity from local purchases of equipment, supplies, and services; induced economic activity from purchases of goods and services by project workers; and changes in the sources of income for local governments. The largest economic benefit from CBM development is the methane itself, measured by the revenues obtained by the companies involved in developing the resource. It is assumed that most of these revenues would go to out-of-state companies. Montana's share of that benefit would come mostly in the form of natural gas taxes and royalties, discussed below.

Conventional oil and gas development would have economic impacts on landowners, communities, county governments, reservations, and the state and Federal governments. When hydrocarbons are produced and sold, the operator is responsible for paying the mineral owner and governmental entities in the form of taxes and royalties. New employees generally would be needed as wells are added; for example, drilling contractors and other contractors would be required to service and supply the wells to maintain production. At the same time, an increase in wells would impact the community through an influx in population which, in turn, would result in increased pressure on community services such as schools, roads, medical facilities, and other public services.

Property values would be affected by full field development. Full-size ranches would be impacted by the increase in activity accompanying development. This could include such factors as the change in rural character of the land. Ranchers choosing to sell their ranches would receive less monetarily if the ranch sells without mineral rights attached. Outfitting would be impacted from increased road development, causing a decline in outfitting income.

Oil and gas development would impact social and economic resources through influence on area employment, taxes, Payments in Lieu of Taxes, royalties to mineral owners, and county, state, and federal services. It might also affect local environmental resources, from which many residents make their living. Conventional well development is projected at between 595 to 2,325 additional oil and gas wells over the next 20 years. This level of industrial activity (average 116 wells per year) would have negligible impact on the social economic resources of the area.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Employment and Unemployment

The location and distribution of the exploratory wells by county is not known, and therefore, this analysis assumes that the wells in the two RMPs are distributed across those areas and the wells to be drilled statewide are also distributed geographically in proportion to the RFD estimates for development. The production wells are assumed to be confined to the CX Ranch in Big Horn County.

Average numbers and types of jobs and their associated wages are estimated based on a recent report on the economic impacts of CBM development in the Powder River Basin (ZurMuehlen 2001), which assumes the following ratios: 49 jobs per 160 wells for exploration/development; 9 jobs per 160 wells for production; and 12 jobs per 160 wells for abandonment. As shown in Table 4-48, the estimated number of jobs created under Alternative A would range between 175 (Year 1) and 14 (Years 8 through 19), for an average of about 32 jobs per year over the period. This change would be small compared to the total employment in the CBM emphasis area (183,000 in 1998). For Alternative A, it is assumed

TABLE 4-48

ALTERNATIVE A: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION, AND ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1]

Year	Wells Drilled per Year	Initial Development Jobs	Initial Development Wages[2]	Wells Producing per Year	Production Jobs	Production Wages	Wells Abandoned per Year	Abandonment Jobs	Abandonment Wages	Estimated Total Jobs	Estimated Total Wages
1	525	161	$4,662,656	250	14	$539,063				175	$5,201,719
2	150	46	$1,332,188	250	14	$539,063				60	$1,871,250
3	150	46	$1,332,188	250	14	$539,063				60	$1,871,250
4	100	31	$888,125	250	14	$539,063	375	28	$972,656	73	$2,399,844
5				250	14	$539,063	100	8	$259,375	22	$798,438
6				250	14	$539,063	100	8	$259,375	22	$798,438
7				250	14	$539,063	100	8	$259,375	22	$798,438
8				250	14	$539,063				14	$539,063
9				250	14	$539,063				14	$539,063
10				250	14	$539,063				14	$539,063
11				250	14	$539,063				14	$539,063
12				250	14	$539,063				14	$539,063
13				250	14	$539,063				14	$539,063
14				250	14	$539,063				14	$539,063
15				250	14	$539,063				14	$539,063
16				250	14	$539,063				14	$539,063
17				250	14	$539,063				14	$539,063
18				250	14	$539,063				14	$539,063
19				250	14	$539,063				14	$539,063
20				250	14	$539,063	250	19	$648,438	33	$1,187,500
20-Year Total	**925**	**283**	**$8,215,156**	**250**	**14[3]**	**$10,781,250**	**925**	**69**	**$2,399,219**	**634**	**$21,395,625**

NOTES:

[1] Data for jobs per well and wages (ZurMuehlen 2001).

[2] Wages paid for initial development phase for well drillers and pipeline installers was estimated at $6,600 per well (Langhus 2001)

[3] The same number of jobs are assumed to last for the duration of the planning period.

that all wells would be abandoned by year 20 of the project.

Measurable indirect changes to local employment would not be anticipated for Alternative A. The purchase of equipment, supplies, and services related to the proposed wells would have some impact but likely would not be distinguishable from the existing economic activity in the CBM emphasis area and in the state.

Thus, few or no new jobs would be created indirectly. New employment created directly and indirectly for Alternative A would be small in relation to total employment in the CBM emphasis area (183,000 in 1998), and therefore, it would not be expected to result in changes to current county or state unemployment rates.

Demographics

Employees who would fill the CBM jobs would likely be a mixture of current residents from the surrounding areas and those who would be drawn to the project and its employment opportunities from around the region. It is assumed that local labor (i.e., those within commuting distance of the CBM well locations) would be used to the extent available; however, many of the new jobs would likely be filled by new migrants to the region. The degree to which the jobs would be filled by current residents would depend on a number of factors, including job skills. The extent to which workers who move to the region for new jobs would bring families with them would depend on a number of factors, most notably the duration of the job in a given location. Assuming a mixture of single employees and those with families, it is estimated that, on average, each new employee would bring one additional person to the region. Even if all the jobs (175 during Year 1) were filled by new migrants to the region and resulted in new persons moving to the area, the total new population (perhaps 350 persons) would be small compared to the total regional population (287,000 in 2000). There would likely be some concentration of new residents associated with jobs in Big Horn County related to the CX Ranch. Given that any new population would be spread over both time and geographic area, no change in demographics would be anticipated from Alternative A.

Social Organization

Housing Units and Vacancy

Only small changes in the supply or demand of permanent or temporary housing are anticipated as part of Alternative A. This follows from the small changes in employment and population discussed above. However, there could be short term localized housing shortages depending on the size of the population increase in Big Horn County.

Public Services and Utilities

The relatively small scale of CBM well development would not result in any substantial changes in the ability of county, state, or Federal governments to provide public services or utilities. The basis for this conclusion is the lack of additional temporary or permanent population and the associated lack of demand for additional public services. However, there could be short term localized increases in public services demands depending on the size of the population increase in Big Horn County.

Attitudes, Beliefs, Lifestyles, and Values

The limited development of CBM proposed for Alternative A likely would be experienced by the communities in the CBM emphasis area as a continuation of existing oil and gas development practices in the region and in the state. As a result, these actions by themselves would likely be perceived as generally consistent with the attitudes, beliefs, lifestyles, and values of most population groups (e.g., ranchers, Native Americans, small town residents).

Personal Income

Wages paid to project employees would contribute to the total personal and per capita income of every county where employees reside. As shown in Table 4-48, total direct wages from Alternative A over 20 years are estimated at about $21 million, and would range from a high of $5.2 million (Year 1) to a low of $539,000 (Years 8 through 19).

Any of the producing wells proposed for operation on the CX Ranch would generate new personal income, depending on ownership. Individuals who own the mineral rights to their land and lease those rights to developers as part of the existing management scenario would receive additional income from rents or royalties. Although only a small percentage of landowners own mineral rights, the royalty income to any one individual would still be substantial over many years if a given well is highly productive. Individuals on whose land CBM is developed but who do not own the mineral rights to their land would receive one-time payments as compensation for land disturbance. However, given the small scale of production anticipated, these changes to personal income likely would have only a small effect on the per capita income of the CBM emphasis area or the state as a whole.

Additional personal income for residents of the counties and the state would be generated by circulation and re-circulation of dollars paid out as business expenditures and as state and local taxes.

Government Revenues

The primary source of government revenues generated by the project would be from taxes levied on property, equipment, income, and natural gas output generated by production wells. Exploratory wells would generate government income only to the extent the associated temporary facilities are subject to local property taxes.

Oil and Gas Income

Royalties of 12.5 percent are typically earned for oil and gas production on state and federal lands. About 50 percent of royalties paid to the federal government are generally returned to the state from which they originate. Assuming the 250 production wells on the CX Ranch proposed for Alternative A each generate about $182,500 in gross production income per year (assuming production of 125,000 cubic feet per day and a price of $4.00 per thousand cubic feet), the total annual gross income would be about $45.6 million per year for an average of 15 years. About 12.5 percent, or $5.7 million, of this new income would accrue to the state, federal, or private mineral owner annually.

Rents on state and federal lands leased for oil and gas development are bid competitively, with the lowest bid being $1.50 per acre. Resulting government income would depend on the specifics of leases on the CX Ranch; however, it is assumed that additional income would accrue to the state and federal government.

Taxes

Income Taxes

A portion of the taxable income (wages, rent or royalty income, and land disturbance payments) generated by Alternative A would accrue to the state as income tax revenue. Income taxes would be paid on the annual wages paid for the average 32 jobs per year discussed under *Employment*. Dividing the estimated total wages over 20 years by the estimated total jobs for the same period (Table 4-48), the average annual salary per job would be about $34,000. Income in Montana is taxed according to a graduated rate structure with rates ranging from 2 percent to 11 percent of taxable income; the average rate in 2000 was about 3 percent (Montana Department of Revenue 2001). It is important to note that these sums are already included in the estimates of personal income (income taxes are a transfer of personal income to the state). Thus, estimated income tax revenues from an annual average of 32 jobs at $34,000 would range from $21,800 (2 percent tax rate) to $119,700 (11 percent tax rate), with a likely amount closer to $32,600 (3 percent tax rate) based on recent history. The project would result in an increase in state tax revenues to the extent that new income is created that didn't previously exist in the state.

Property Taxes

Both real and personal property are subject to property taxes. Personal property would consist of structures, equipment, and materials used for the proposed exploration and production of CBM. Taxes on real property would be based on changes in the assessed value that result from improvements to the property. Each county in which facilities were located would assess tax levies and apply them to the taxable value of the relevant facilities. The levy would be based on the total value of property multiplied by a tax rate or rates specific to the property location (i.e., county and special service districts). Any such additional property taxes would contribute new income directly to both the county tax base and the local economy. It should be noted that property taxes on business equipment (e.g., drilling equipment) would likely be phased out by 2006, reducing the total taxes that would be collected.

Given the limited nature of CBM exploration and development proposed in Alternative A, changes in taxes are not expected to be substantial for any given county. The exception is Big Horn County, where the new production wells are proposed. Additional county tax revenues would be anticipated. Property tax revenues would be a cost to CBM development companies and landowners and a benefit to the counties and the state.

Natural Resources Taxes

The products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes. Any new production of natural gas generated by the 250 production wells in Big Horn County would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies.

Other Taxes

In general, the local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, because there is no sales tax in Montana, local sales of goods and services associated with CBM development would not generate increases in tax revenues.

Water Resource Values

The purpose of a discussion of water resource values in the *Economics* section of this report is to acknowledge that the existing surface and groundwater resources in the CBM emphasis area have an economic value that is part of the overall economy of the area and that alterations to these resources, would have economic impacts to water users or to the regional economy. Affected users would include those who depend on surface water or groundwater for irrigation, ranching, municipal water needs, home water needs, landscape needs, and any other business and household need of water from a surface water body or well.

Given the relatively limited scale of CBM development proposed for Alternative A, effects on water resources and water resources economics would be relatively limited (see the analysis in the Hydrological Resources section). For Alternative A, untreated water from exploration would be placed in holding facilities for beneficial re-use, which would provide an economic benefit to affected water users. No discharge to waters of the United States would be allowed for BLM-authorized exploration wells; the state would permit discharge for the CX Ranch field of up to 1,600 gpm. Because of the small scale, no economic impacts to downstream surface water users would be anticipated.

Localized groundwater depletion would result over time (more than 5 years) from the CBM wells proposed for Alternative A.

Crow Reservation

Impacts to social and economic values on the Crow Reservation would be small because it is assumed that no CBM wells would be developed on the Reservation initially. Social impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects potential. Few, if any, tax revenues would accrue to Tribal governments as a result of off-reservation CBM development. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer impacts from CBM development.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be small because it is assumed that no CBM wells would be developed on the Reservation. Social impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects potential. Few, if any, tax revenues would accrue to Tribal governments as a result of off-reservation CBM development. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer impacts from CBM development.

Conclusions

The alternate management scenario is a continuation of existing oil and gas industry practices in the CBM emphasis area and would not result in social impacts. They would be only a small effect on economic conditions in the CBM emphasis area, as well as environmental and social conditions. However, there could be short term localized impacts to housing and services in Big Horn County.

The new jobs and related social and economic impacts from Alternative A would be small, with the exception of the proposed production wells in Big Horn County, which would result in positive economic impacts in that county. Future development in the area, such as further expansion of existing surface coal mines, would likely have larger social and economic impacts (e.g., creation of more jobs and income) than those impacts from Alternative A.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Employment and Unemployment

Estimated direct employment from CBM under the development scenario for the 20-year project life is presented in Table 4-49. (Wage information is discussed under *Economics*.) The number and type of jobs involved would vary with the project phase. The

TABLE 4-49

ALTERNATIVES B, C, D, and E: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION, AND ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1, 2]

Year	Wells Drilled per Year	Initial Development Jobs	Initial Development Wages[3]	Wells Producing per Year	Production Jobs	Production Wages	Wells Abandoned per Year	Abandonment Jobs	Abandonment Wages	Estimated Total Jobs	Estimated Total Wages
1	900	276	$7,993,125	510	29	$1,099,688	390	29	$1,011,563	334	$10,104,375
2	1,100	337	$9,769,375	1,220	69	$2,630,625	390	29	$1,011,563	435	$13,411,563
3	2,000	613	$17,762,500	2,830	159	$6,102,188	390	29	$1,011,563	801	$24,876,250
4	2,200	674	$19,538,750	4,640	261	$10,005,000	390	29	$1,011,563	964	$30,555,313
5	2,000	613	$17,762,500	6,250	352	$13,476,563	390	29	$1,011,563	993	$32,250,625
6	1,500	459	$13,321,875	7,750	436	$16,710,938	0	0	$0	895	$30,032,813
7	1,300	398	$11,545,625	9,050	509	$19,514,063	0	0	$0	907	$31,059,688
8	900	276	$7,993,125	9,950	560	$21,454,688	0	0	$0	835	$29,447,813
9	900	276	$7,993,125	10,850	610	$23,395,313	0	0	$0	886	$31,388,438
10	700	214	$6,216,875	11,550	650	$24,904,688	0	0	$0	864	$31,121,563
11	550	168	$4,884,688	11,900	669	$25,659,375	200	15	$518,750	853	$31,062,813
12	550	168	$4,884,688	12,250	689	$26,414,063	200	15	$518,750	873	$31,817,500
13	550	168	$4,884,688	12,600	709	$27,168,750	200	15	$518,750	892	$32,572,188
14	550	168	$4,884,688	12,950	728	$27,923,438	200	15	$518,750	912	$33,326,875
15	550	168	$4,884,688	13,300	748	$28,678,125	200	15	$518,750	932	$34,081,563
16	450	138	$3,996,563	13,550	762	$29,217,188	200	15	$518,750	915	$33,732,500
17	450	138	$3,996,563	13,800	776	$29,756,250	200	15	$518,750	929	$34,271,563
18	450	138	$3,996,563	14,050	790	$30,295,313	200	15	$518,750	943	$34,810,625
19	400	123	$3,552,500	14,100	793	$30,403,125	350	26	$907,813	942	$34,863,438
20	300	92	$2,664,375	14,050	790	$30,295,313	350	26	$907,813	908	$33,867,500
20-Year Total	18,300	5,604	$162,526,875		11,090	$425,104,688		319	$11,023,438	17,013	$598,655,000
Annual Average	915	280	$8,126,343.75		554	$21,255,234.38		16	$551,171.88	851	$29,932,750

NOTES:

[1] Data for jobs per well and wages (ZurMuehlen 2001).

[2] The water management conditions included in Alternative B would require injection wells, the installation and operation of which would be associated with additional jobs. Water injection wells would be required at a rate of about 1 per 10 CBM wells. This would result in an increase in jobs and wages of about 10% over those reported in Table 4-26 for all phases of the project combined.

[3] Wages paid for initial development phase for well drillers and pipeline installers was estimated at $6,600 per well (Langhus 2001).

types of jobs would be the same as those described for Alternative A.

As shown in Table 4-49, development (drilling of about 18,300 wells over 20 years) would result in an estimated average of 851 jobs per year, with a range from 334 (Year 1) to 943 (Year 18) for all project phases combined. The actual number of jobs in a given year would depend on the actual number of wells drilled, in production, or abandoned in that year. Abandonment of wells during years 21-40 would result in an estimated 1,054 additional jobs, for an average of about 53 jobs per year during that period.

The additional jobs created would be small compared to the total employment in the CBM emphasis area (183,000 in 1998). However, given that most of the CBM wells would be located in three counties (Big Horn, Powder River, and Rosebud), a large number of the jobs would be concentrated in those counties. Because some of these jobs would go to non-local residents, the actual number of new jobs in the study area would be less.

The water management conditions included in Alternative B would require injection wells, the installation and operation of which would be associated with additional jobs. Water injection wells would be required at a rate of about 1 per 10 CBM wells. This would result in an increase in jobs and wages of about 10 percent over those reported in Table 4-49 for all phases of the project combined.

In addition to the direct jobs created by the project, some additional jobs would be created indirectly through additional work for persons in related support industries such as truckers, material suppliers, inspectors, and various other specialists. One estimate is that one indirect job would be created for every four direct jobs created (ZurMuehlen 2001).

The effect of the new jobs on current unemployment rates in the area would be moderate. Although the new direct jobs would help boost total employment in the emphasis area, the increases would be limited to those sectors and individuals with the appropriate skills for the jobs and to those geographic locations where the jobs are located. For example, the relatively high unemployment rates (about 9 percent) in the mining sector in Big Horn and Rosebud counties would be decreased if unemployed persons gain employment from the new CBM development.

Any new jobs filled by new residents (see the *Demographics* section) would increase the number of employed persons in a given county but would not decrease the number of unemployed persons. To the extent that indirect jobs are created by the project, some increased employment in other service industries also would occur.

Demographics

As with Alternative A, employees who would fill the CBM jobs would likely be a mixture of current residents from the surrounding areas and those who would be drawn to the project and its employment opportunities from around the region. It is assumed that local labor would be used to the extent it is available; however, for Alternative B it is likely that many additional workers (e.g., drill rig crews) from outside the area would be needed, especially during the peak employment years of the project. It is assumed that drill rigs from a variety of locations-both Montana and Wyoming-would be used, depending on supply and demand at any given time. The potential for new population is greatest in the counties where the number of CBM wells to be drilled is greatest: Big Horn, Powder River, and Rosebud counties (about 90 percent of proposed CBM wells would be drilled in these three counties; see Table 4-50). As with Alternative A, it is estimated that, on average, each new employee would bring one additional person to the region. Assuming, for example, that all of the jobs were filled by new migrants to the area, as many as 1,986 people (993 x 2) might be added to the region during the peak employment year (Year 5). An increase of this magnitude would be small compared to the total regional population (287,000 in 2000). However, the new population could be concentrated in the three counties with the most CBM wells (see Table 4-50).

Because these three counties have a relatively small combined population (about 24,000), population change within these counties could be substantial. Of the approximately 24,000 persons in the three counties, about 10,400 or 44 percent are Native American (see Chapter 3).

Social Organization

Housing Units and Vacancy

Depending on the type and duration of the jobs (e.g., long-term production supervisor versus drill rig crew member), new employees in the area would seek either temporary housing (hotels, apartments, trailer parking) or permanent housing (homes to purchase or to rent

TABLE 4-50
TOTAL PROPOSED WELLS AND PERCENT BY COUNTY
(ALTERNATIVES B, C, D, AND E)

County	Wells to be Drilled	Percent of Total
Big Horn	7,000	38.3%
Blaine	10	0.1%
Carbon	400	2.2%
Carter	0	0.0%
Custer	300	1.6%
Gallatin	15	0.1%
Golden Valley	0	0.0%
Musselshell	150	0.8%
Park	25	0.1%
Powder River	6,700	36.6%
Rosebud	2,800	15.3%
Stillwater	700	3.8%
Sweetgrass	25	0.1%
Treasure	25	0.1%
Wheatland	0	0.0%
Yellowstone	150	0.8%
Subtotal	18,300	100.0%
Combined Total: Big Horn, Powder River, and Rosebud counties	16,500	90.2%

long-term). Individual choices about where to live are hard to predict and vary with personal preference, in addition to the supply of housing and availability of services in a given location and the mobility demands of a given job. The relatively limited supply of temporary and permanent housing in the smaller communities in the CBM emphasis area would limit the number of new employees (and families, if applicable) who would be able to live there without additional housing and related services. The larger communities, such as Billings or Gillette and Sheridan, Wyoming, have a greater supply of temporary and permanent housing and would be likely settlement locations for people employed by the CBM industry. In part because of the general trend of migration within Montana from the east to the west during recent years, vacant housing is available in a number of communities. As discussed in Chapter 3, vacancy rates for both temporary and permanent housing are adequate to high in the CBM emphasis area. This information, combined with the large size of the geographic area and the dispersed nature of the new job opportunities and associated new population, suggest that adequate housing opportunities would be available in the larger communities but might not be available in some of the smaller communities.

Public Services and Utilities

Impacts on the ability of local governments to provide public services and utilities would be related to the ability of the service providers to adapt to relevant fiscal or physical changes from CBM development. Affected services typically include police and fire protection, emergency medical services, schools, public housing, park and recreation facilities, water supply, sewage and solid waste disposal, libraries, roads, and other transportation infrastructure. Given the large geographic scale of the CBM development scenario, it is infeasible to quantitatively assess the relationship of the project to these individual services. Effects would be greatest in the three counties (Big Horn, Powder River and Rosebud) where most of the CBM wells are proposed to be drilled; however, these counties would also receive the greatest amounts of property tax and other government revenues (see the

Economics section) that would fund improvements or other changes to services.

The alternatives being considered include varying management objectives with respect to the construction of roads and utilities. The construction and maintenance of utilities would be funded by the users. The decision as to whether to maintain roads upon abandonment of CBM facilities would be up to the land owner, which could be either a public or private entity. To the extent local governments opt to maintain these roads after this time, additional revenue would be required to balance the additional costs required to do so.

Attitudes, Beliefs, Lifestyles, and Values

The large scale development of a large number of CBM wells in the planning area would likely conflict with the attitudes, beliefs, lifestyles, and values of many individuals and population subgroups in the area (e.g., farmers, ranchers, small town residents, Native Americans, retirees, etc.). Drilling, testing, and operation of CBM wells would result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the planning area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They would likely find CBM development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. This would be particularly true for Big Horn, Powder River, and Rosebud Counties where the majority of the wells would be developed. Large-scale CBM development could be viewed as part of a gradual transition away from traditional rural and agricultural lifestyles. A smaller group of people in the area who are more interested in the potential economic benefits of CBM development would likely perceive or experience fewer impacts with respect to lifestyles and values.

Large-scale CBM development is likely to conflict to some degree with traditional Native American values which emphasize preservation of cultural heritage and a reverence for the natural environment. Native American groups could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as they affect locations and resources used for spiritual or religious purposes. It is assumed that no CBM wells would be developed on the Native American reservations initially, and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer harmful impacts from CBM development.

Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

The subsurface discharge of produced water would likely be seen as consistent or somewhat inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. Impacts on groundwater would be the same for Alternatives B, C, D, and E, with the primary impact being the drawdown of groundwater.

Personal Income

Wages paid to CBM workers would contribute to the total personal income in the county where the employees reside. As shown in Table 4-49, wages would be generated from all three project phases. Over the first 20 years of the project, total wages paid for all phases of the project would be an estimated $598 million. Estimated annual wages would range from $10 million in Year 1 to almost $35 million in Years 18 and 19. Although this much estimated personal income would be generated by the project, it would not all be experienced as “new” income within a given county or the state. New income would be the difference between the income of workers before CBM development and the income after CBM development.

A number of the producing wells in the development scenario would generate new personal income for those who own the land or the mineral rights, as stated under Alternative A. The circulation and re-circulation of direct income (including royalties to private owners) generated by the project would generate additional (indirect) personal income throughout the region.

Government Revenues

Oil and Gas Income

Assuming each of the approximately 16,500 production wells anticipated for Alternative B generate about $182,500 in gross production income per year of operation, the total annual gross income would vary depending on the number of wells in production in a given year. As shown in Table 4-49, the estimated number of producing wells ranges from 510 in Year 1 to 14,100 in Year 19. It follows that the estimated annual gross income would range from $93 million (Year 1) to $2.5 billion (Year 19). Most of this revenue would go to methane companies and would accrue to the companies in the states where they are located. The 12.5 percent royalty collected on this annual income would range from about $12 million (Year 1) to $322 million per year. It is estimated that about one-half the well sites would be permitted on minerals administered by the federal government (BLM) about 5 to 10 percent on state (fee) minerals, and the remaining 40 to 50 percent on private minerals. As a result, about half of the royalty income would initially go to the federal government, with about half of the federal half being returned to the state. Thus, an estimated 30 to 35 percent of royalty income, between $4 million and $113 million in a given year, ultimately would accrue to the state. Given that total state revenues received from minerals management on state lands in FY 2000 was $11.6 million and total federal mineral revenues collected on Montana lands and disbursed to the state were $20.4 million in FY 2000 (see Chapter 3), new state revenues from CBM would be substantial, especially during the peak years of the project.

Rents on state and federal lands leased for oil and gas development are bid competitively, with the lowest bid being $1.50 per acre. Resulting government income would depend on the specifics of the leases. It is assumed that additional income would accrue to the state and federal government from these rents.

Net government revenues would be reduced by costs incurred for monitoring and regulating CBM activity. These costs would be relatively small compared to the revenues generated.

Water treatment costs for Alternative B would be greater than for Alternative D and much greater than for Alternative C.

Taxes

Income Taxes

A portion of the taxable income (wages, rent or royalty income, and land disturbance payments) generated by Alternative B would accrue to the state as income tax revenue. Income taxes would be paid on the annual wages paid for the average 851 jobs per year discussed above under *Employment*. Dividing the estimated total wages over 20 years by the estimated total jobs for the same period (Table 4-49), the average annual salary per job would be about $35,000 (does not account for inflation over time). Income in Montana is taxed according to a graduated rate structure with rates ranging from 2 percent to 11 percent of taxable income; the average rate in 2000 was about 3 percent (Montana Department of Revenue 2001). It is important to note that these sums are already included in the estimates of personal income (income taxes are a transfer of personal income to the state). Thus, estimated income tax revenues from an annual average of 851 jobs at $35,000 would range from $596,000 (2 percent tax rate) to $3.3 million (11 percent tax rate), with a likely amount closer to 894,000 (3 percent tax rate) based on recent history. As discussed above, the project would generate new income tax revenue for the state to the extent that revenue generated by new jobs, for example, exceeds existing tax revenues. The income tax sums are already included in the estimates of personal income.

Property Taxes

See general discussion of property taxes for Alternative A. Only at the time when a given property is improved (i.e., a CBM well or other facilities are developed there) would estimated new property tax revenues be calculated. However, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River, and Rosebud counties would have the vast majority of new wells; therefore, they would be anticipated to experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services, and other county assets, after any new costs associated with CBM are accounted for.

Natural Resources Taxes

Natural resources taxes would be greater than described under Alternative A because they would be based on 18,000 wells.

Other Taxes

Other taxes would be the same as described under Alternative A.

Water Resource Values

Surface discharge of produced water would be prohibited, and therefore surface water impacts such as erosion and water quality would be avoided. In the absence of surface water impacts, no associated economic impacts to surface water users would occur.

The primary impact to groundwater resources is removal of groundwater in the Powder River Basin watersheds affecting wells and springs.

Crow Reservation

Social and economic impacts from off-Reservation development in Alternative B would include creation of a limited number of new jobs in the emphasis area and related demographic shifts from people moving to the area. It is anticipated that the impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Some additional demands on public services also would result.

See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on effects to Native Americans.

As shown in the RFFA, 4,000 wells could be developed on the Crow Reservation. If this entire number of wells were developed, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, a drawdown in groundwater, and additional personal income and revenues from CBM development and production.

Indian allottees, and the Crow Tribe would receive access, damage payments, royalties, and possible taxes revenues.

Northern Cheyenne Reservation

Social and economic impacts from off-Reservation development in Alternative B would include creation of a limited number of new jobs in the emphasis area and related demographic shifts from people moving to the area. It is anticipated that the impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Some additional demands on public services also would result.

See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on effects to Native Americans.

As shown in the RFFA, 4,000 wells could be developed on the Northern Cheyenne Reservation. If this entire number of wells were developed, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, a drawdown in groundwater, and additional personal income and revenues from CBM development and production.

Indian allottees, and the Northern Cheyenne Tribe would receive access, damage payments, royalties, and possible taxes revenues.

Conclusion

The primary social impacts identified from Alternative B would be the new jobs created in the emphasis area as a result of development and change from a predominantly rural and agricultural based lifestyle. These new jobs would result in some demographic shifts as a result of people moving to the area. It is anticipated that the impact of added employment and population on social conditions would be small overall but that impacts in the three counties with the most CBM activity could be greater. Alternative B would result in the generation of new personal and government income. New personal income would include the wages from both direct and indirect jobs created by the project, as well as income from land disturbance payments and mineral leases. Similarly, new local, state, and federal government income would be generated through the variety of means discussed. Over the long term, there is the possibility of a “boom and bust” cycle as CBM activity rises and falls.

As shown in the RFD scenario presented in the Minerals Appendix, in addition to the 18,300 CBM wells considered for Alternative B, an additional 8,200 CBM wells would be developed in this area in the future: 4,000 on the Northern Cheyenne Reservation, 4,000 on the Crow Reservation, and about 200 wells on USFS land. This number is about 44 percent of those proposed for Alternative B. If this entire number of wells was developed over the same 20-year period as the other 18,300 wells, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, additional population, additional demands on public services, a drawdown in groundwater, and additional personal income and government revenues from CBM development and production. Potentially large social and economic impacts also would result from other developments proposed for the area, including expansion of existing surface coal mines. The impacts from these other developments would be additive to those identified above for Alternative B.

Alternative C—Emphasize CBM Development

Employment And Unemployment

Employment and unemployment would be the same as described under Alternative B, except that there would be no additional jobs created from installation of injection wells, which would not be required for this alternative.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B.

Attitudes, Beliefs, Lifestyles, and Values

General impacts on population subgroups are the same as for Alternative B.

Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

Alternative C would allow discharge of untreated water to the land surface. As indicated in the Hydrological Resources section, this discharge would result in erosion and water quality impacts. Such impacts would be inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. The primary reasons for this conclusion include the potentially large scale of this discharge, the potential for degraded water to negatively affect farming and ranching operations (e.g., reduce economic viability), increased noise, loss of natural scenery, and the inconsistency of this approach with the rural lifestyles and values discussed in Chapter 3.

Personal Income

Personal income would be the same as described under Alternative B, with the possible exception of decreases in farming or ranching income as a result of water quality and erosion impacts. See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on social effects to lifestyles and Values.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be about the same as described under Alternative B. Water treatment costs would be less than for Alternative B due to the allowance of discharge to the land surface (see Water Resource Values below).

Taxes

Income Taxes

Income taxes would be the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

See the discussions for Alternative B. Alternative C would allow discharge of untreated water to the land surface. As indicated in the Hydrological Resources section elsewhere in this document, this discharge would result in erosion and water quality impacts. In turn, some downstream surface water users who depend on surface water resources for their livelihood would be affected (for example, if suitable irrigation water were no longer available or if ranch land were lost to erosion). See further discussion under Attitudes, Beliefs, Lifestyles and Values, above. Groundwater impacts would be similar to Alternative B. A difference is that no groundwater would be reinjected as it would for Alternative B, possibly increasing the risk of groundwater drawdown in some locations.

Crow Reservation

Impacts from Alternative C would include creation of a limited number of new jobs in the emphasis area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Crow Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Somewhat greater impacts on water resource users and on lifestyles and values would occur compared to Alternative B. See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Social and economic impacts from development in Alternative C would include creation of a limited number of new jobs in the emphasis area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Northern Cheyenne Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Somewhat greater impacts on water resource users and on lifestyles and values would occur compared to Alternative B. See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on social effects to Native Americans.

Conclusions

Residual impacts would be similar to those for Alternative B, except for impacts to lifestyles and water resource values, which would be greater for Alternative C than for Alternative B.

Cumulative impacts would be greater than for Alternative B, given the water resource impacts.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Employment and Unemployment

Employment and unemployment would be the same as described for Alternative B.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B.

Attitudes, Beliefs, Lifestyles, and Values

General impacts on population subgroups are the same as for Alternative B.

Impacts on recreation areas would include the loss of land for recreation purposes, and the disruption to recreation activities. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

Treatment of most produced water and discharge via pipeline or other constructed water courses would eliminate most of the erosion and water quality impacts.

Personal Income

Personal income would be the same as described under Alternative B, with the possible exception of decreases in farming area ranching income as a result of water quality and erosion impacts. See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on social effects to lifestyles and Values.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be the same as described under Alternative B. Water treatment costs would be greater than for Alternative C and much less than for Alternative B.

Taxes

Income Taxes

Income taxes would be the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

See discussion for Alternatives B and C. Most discharge would be treated and carried over land in pipes. Surface water impacts and the potential for resulting economic impacts to surface water users would be less than for Alternative C and greater than for Alternative B. Groundwater impacts would be the same as Alternative C.

Crow Reservation

Impacts from Alternative D would include creation of a limited number of new jobs in the emphasis area and related demographic shifts from people moving to the area. It is anticipated that the impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Crow Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Additional impacts on water resource users and on lifestyles and values would occur but they would be less than for Alternative C. See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Social and economic impacts from Alternative D would include creation of a limited number of new jobs in the emphasis area and related demographic shifts from people moving to the area. It is anticipated that the impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Additional impacts on water resource users and on lifestyles and values would occur but they would be less than for Alternative C. See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on social effects to Native Americans.

Conclusions

Residual impacts would be similar to those for Alternative B, except with respect to impacts on water resource economics and related lifestyle impacts, which would be less than Alternative C but greater than Alternative B.

Cumulative impacts would be less than Alternative C and somewhat greater than Alternative B, given the differences in water resource impacts.

Alternative E—Preferred Alternative

Employment and Unemployment

Employment and unemployment would be the same as described under Alternative B. It is assumed that the approximate number of additional jobs created from installation of injection wells required for Alternative B would also occur for Alternative E, except that some of the jobs would be associated with the variety of site-specific produced water management options.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would the same as described under Alternative B, except that the oil and gas roads would remain open or be closed at the surface owner's discretion, potentially increasing or decreasing the burden on public jurisdictions to maintain these roads.

Attitudes, Beliefs, Lifestyles, and Values

General impacts on population subgroups would be the same as for Alternative B.

Alternative E would have impacts on water resources and water resource values that are similar to the impacts of Alternative B and Alternative D (see *Hydrological Resources* section).

Personal Income

Personal income would be the same as described under Alternative B.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be about the same as described for Alternative B, although water treatment costs could be greater, thus potentially decreasing the net income to producers.

Taxes

Income Taxes

Income taxes would the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resource Taxes

Natural resource taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

Alternative E would have impacts on water resources and water resource values that are similar to the impacts of Alternative B and Alternative D (see discussion in *Hydrological Resources* section). The activities proposed to prevent the degradation of surface and groundwater resources would substantially reduce erosion and surface water quality impacts.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative E. Social and economic impacts would include creation of a limited number of new jobs in the emphasis area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Compared to other alternatives, oil and gas income could be less, depending on water treatment costs. See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described above for Alternative E. Social and economic impacts would include creation of a limited number of new jobs in the emphasis area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Compared to other alternatives, oil and gas income could be less, depending on water treatment costs. See the Attitudes, Beliefs, Lifestyles and Values section under this alternative for additional information on social effects to Native Americans.

Social and economic impacts from CBM development on federal lands would be mitigated as described in the Northern Cheyenne Mitigation Appendix. However, most measures focus on preventing the loss of tribal resources such as CBM water. The BLM would consult with the Tribe where site-specific analysis identifies social or economic impacts on the Reservation.

The Northern Cheyenne Tribe can require their special socioeconomic mitigation measures in tribal leases on the reservation.

Conclusions

Residual impacts would be similar to those for Alternative B, with the exception of the reduced impacts on lifestyles and values and water resource values that would result from the proposed measures to prevent the degradation of water resources.

Cumulative impacts would be somewhat less than for Alternative B, given the greater variety of control measures that would be used to prevent water resource impacts.

Environmental Justice

Environmental Justice
Executive Order 12898 requires the non-discriminatory treatment of minority and low-income populations for projects under the jurisdiction of a federal agency

Alternative A
No Action (Existing CBM Management)

- No adverse impacts with the exception of the undetermined Wyoming discharge influence. It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana river's would constitute a potential environmental justice issue if unresolved. No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.

Alternative C
Emphasize CBM Development

- Same as B except for adverse environmental effects would be expected from downstream water quality changes resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.

Alternative E
Preferred CBM Development Alternative

- No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.
- Impacts would be mitigated as described under the Environmental Justice section, Alternative A and by implementation of the Project Plan requirements.

Assumptions

The purpose of this analysis is to report whether high and adverse human health or environmental effects of the proposed alternatives are likely to fall disproportionately on minority or low-income populations. This analysis focuses on the populations that are located within the areas potentially affected by the alternatives. It examines where expected high and adverse impacts, if any, fall relative to minority and low-income populations. In order to make a finding that a proposed project is inconsistent with the Environmental Justice policy established in Executive Order (EO) 12898 and described in Section 4.10.1.7, two situations must occur at the same time: 1) there must be a minority or low-income population; and 2) that population must receive a disproportionately high and adverse environmental or human health impact.

Two options are considered depending on what the impacts are:

- If adverse impacts are identified in the resource analyses, the individual occurrence potential is analyzed for disproportionate effects on minority and/or low-income populations.
- If no adverse impacts are identified in the resource analyses, then no environmental justice issues would be expected as a result of the alternative. Therefore, it can be concluded that no adverse human health or environmental effects would fall disproportionately on minority or low-income populations. Consequently, none of the impacts of the alternative can be described as having a high and adverse impact in the context of EO 12898. The proposed alternatives are therefore consistent with the policy established in EO 12898.

Impacts from Management Common to All Alternatives

Current management of conventional oil and gas resources does not appear to be disproportionately impact minority populations.

Under management common to all alternatives, the EO and guidance would continue to provide for minority participation in future BLM management decisions.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

A review of the impact analyses prepared for the existing management alternative did not reveal adverse impacts that warrant further analysis for disproportionate effects to minorities or low-income populations. The exception is the potential impact of CBM-produced waters being discharged into the Little Bighorn River and the Tongue River Reservoir from Wyoming CBM activities. See reservation discussions below.

Crow Reservation

The Little Bighorn River, which originates in Wyoming and flows onto the Crow Reservation, could experience impacts to its water quality. The changes in water quality would be dependent upon the terms of the Final Water Quality Agreement signed between Montana and Wyoming. The current interim agreement does not address the Little Bighorn watershed. Impacts could range from a negligible effect to a modest increase in SAR, Total Dissolved Solids (TDS), EC, and bicarbonate. If the agreement allows for some CBM-produced water to be discharged into the Little Bighorn River, the resulting downstream water would increase SAR, EC, TDS, and bicarbonate, thus the tribe's beneficial use of that water may be diminished as well as the tribe's ability to market their water as a commodity. No health effects are foreseen from the change in water quality or the consumption of downstream fish present in the Little Bighorn River.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne's Water Right in the Tongue River Reservoir would be the result of Wyoming allowing CBM-produced waters to be discharged into the Tongue River, altering the water quality of the reservoir. The range of water quality changes would be dependent upon the Final Water Quality Agreement between Montana and Wyoming. Current policy in Wyoming is that there would be not discharge of CBM-produced water into the Tongue River. The scenarios for possible impact ranges are described in detail in the Hydrological Resources section of this chapter. Worth mentioning though, is that even a slight change in water quality to the reservoir could impact the Northern Cheyenne's ability to market their water as a commodity and reduce their own beneficial uses.

Conclusion

The potential impacts to the surface water concerns of both tribes would be somewhat alleviated by their participation in the state-to-state discussions regarding the Water Quality Agreement. If either tribe were to obtain self-governance over their water quality, they could act with the authority of a state and set their own water quality or non-degradation standards and negotiate with Wyoming for an altered agreement more in line with their specific needs and concerns. Currently, the Northern Cheyenne are working with the EPA to adopt draft water quality standards and obtain primacy for their surface water.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

A review of the resource analyses conducted for Alternative B identifies the following impacts that warrant further review for disproportionate effects on minority or low-income populations. The impacts included in this evaluation are the drawdown of groundwater; air quality changes; and changes to vegetation and soils.

Groundwater Drawdown

CBM production in Montana would result in the depletion of an estimated 23 percent (ALL 2001b) of the groundwater resources in the productive coal seams beneath Montana's Powder River Basin watersheds. This drawdown would be basinwide and correspond to the geographical distribution of production wells. The occurrence potential is not localized and would not impact segregated portions of the population; the impact would be felt evenly across the region. Furthermore, the drawdown has the potential to reduce surface water flows in some drainages depending on specific site conditions. The availability of groundwater is important, as many rural families depend on the supply of groundwater for their household and ranch/agricultural (irrigation) applications.

Air Quality Changes

CBM development in the Powder River Basin would necessitate the construction of many minor emission sources spread out over a very large area. The air quality modeling shows potential air quality impacts at downwind mandatory Federal PSD Class I areas, and that other "sensitive receptors" would exceed the PSD Class I NO_2 increment; cause nitrate and sulfate atmospheric deposition (and their related impacts) in sensitive lakes; and cause perceptible visibility impacts (regional haze). Additionally, there is the potential for the NAAQS to be exceeded for NOx in the Spring Creek Coal Mine area. However, it should be noted that these findings are representative of the maximum potential air quality impacts.

Generally, the potential changes in air quality from development would be within acceptable limits, widespread and distributed across the region. The impacts associated with the dispersion of air pollutants across the region would not be disproportionately distributed upon any minority or low-income groups.

Crow Reservation

Under this alternative, a 2-mile buffer zone would be enforced on federal mineral development around the reservation to restrict development of minerals adjacent to these boundaries. This buffer zone would delay some of the groundwater drawdown impact associated with federal pumping but would not prevent state and private mineral estates from being developed adjacent to the reservation. Therefore, drawdown could affect Indian populations within the Crow Reservation adjacent to off-reservation development.

The Crow tribal government derives some of its income from operator lease fees: ranchers and irrigators operating both on private and reservation lands. If these operators were to experience a reduction in available groundwater that impacted their operations and the Crow Tribe subsequently had to reduce their changed the fees, the tribe would lose a portion of their income. Trust agencies might be needed to resolve conflicts. The form of resolution most desirable would be the replacement of water resources and the according adjustment in fees. If the replacement of water resources could not be achieved because of site-specific conditions or other variables, the loss in potential income generation from reduced fees and limited new fee opportunities would have to be made up for or this could be an environmental justice issue.

Northern Cheyenne Reservation

The Northern Cheyenne Tribe would experience similar groundwater drawdown and potential operator lease fee issues as discussed under the Crow Reservation section above.

As described under the above Air Quality Changes section, the air quality modeling shows potential air quality impacts at downwind mandatory Federal PSD Class I areas and the Northern Cheyenne's PSD Class I area, as well as causing a small increase in perceptible visibility impacts (regional haze). However, these findings are representative of the maximum potential air quality impacts.

Conclusions

If the Northern Cheyenne and Crow tribes elected to develop their CBM resources the federal buffer zone would not be used to limit the effect on the reservation. An additional percentage of drawdown would be experienced across the basin watersheds from the Northern Cheyenne and Crow tribal developments (see Hydrological Resources section for details). If the tribe's CBM resources were drilled to the degree estimated in the RFFA (4,000 wells for each reservation), the depletion of the coal seam aquifer groundwater resource could increase across the region and cause a hardship on numerous low-income and minority populations, which are prevalent throughout the area. However, water well and spring mitigation agreements required by the MBOGC, BLM, and TLMD would provide alternate sources of water due to groundwater lost to the drawdown of resources within the coal seam aquifers. Drawdown in non-producing coal seams aquifers is not anticipated. Replacement may not be possible in some areas with concentrated CBM production. This represents a possible environmental justice issue if the non-replacement areas are adjacent to reservation boundaries and no suitable water is available for mitigation.

No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved. It is concluded that no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.

Alternative C—Emphasize CBM Development

The resource analyses performed for Alternative C indicate that groundwater drawdown, and changes to the surface water quality and the subsequent impacts on vegetation, wildlife, and aquatic resources would have effects that warrant further review for disproportionate effects on minority or low-income populations.

Groundwater Drawdown

The drawdown of groundwater within the Powder River Basin watersheds would have greater effects than described under Alternative B. Without the federal development buffer zone around Indian reservations, drawdown effects could be amplified and appear sooner on reservation properties than under Alternative B.

Surface Water Quality

Under Alternative C, the quality and quantity of surface waters in the Powder River Basin watersheds could be altered depending on the outcome of the statewide water quality standards. The MDEQ is in the process of setting statewide water quality standards that would likely include the framework for managing surface discharge of CBM-produced water throughout the state. The watersheds would most likely experience increases in SAR values, sedimentation, TDS, and a marginal increase in base flow as described in the Hydrological Resources section of this chapter. Based on SAR values, the addition of untreated CBM-produced waters with high SAR values under the least restrictive extreme criteria would not exceed an SAR value of 12. High-quality watersheds in the CBM emphasis area would have adequate assimilative capacity to accept expected discharges from full-scale development of CBM. All other watersheds should only experience a slight increase in SAR, which would remain below the suggested not to exceed a value of 3 for some soils and possibly as high as 12 for others.

It is assumed that the sodium content of produced CBM water is the target contaminant that determines the usefulness of the water for crop irrigation. Irrigation uses the majority of water resources in those watersheds thought to have the greatest potential for CBM development. Sodium causes osmotic stress to plants and destroys the texture of clayey soils; these combined effects make sodium content, and especially SAR, a point of emphasis when gauging impacts to water resources from CBM water. Other parameters such as TDS, nitrogen, and barium concentration may be locally important in determining restrictions to beneficial use. It is assumed that discharge to high-quality watersheds would be limited during the irrigation season and managed on a flow-based discharge scenario. Under these circumstances, high-quality watersheds in the CBM emphasis area would have sufficient capacity to meet the current irrigation needs. Flow-based discharge would however, require additional storage of produced water during the irrigation season for later discharge when stream flows are less sensitive to being impacted by produced water discharges.

The consequential downstream effects of increased SAR and base flow would result in the erosion of riparian areas along rivers, the reduction of both vegetation and wildlife habitat, and the impairment of fish populations. These consequential effects are mentioned because of the large number of Native Americans who have a traditional reliance on the natural agriculture for sacred plants used in medicines and for their hunting and fishing way of life. If these combined water quality impacts are realized, there could be a disproportionate effect felt by the Native Americans as it reduces their ability to gather sacred plants and limit their hunting and fishing opportunities. A large percentage of the population in Big Horn (61 percent) and Rosebud (33 percent) counties are Native Americans and constitutes a sizeable minority population within the CBM emphasis area.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the CBM emphasis area. The reservation can expect impacts to Bighorn, Little Bighorn, Rosebud, and Squirrel Creek watersheds, such as increased flow volume, changes to water quality parameters, including SAR, EC, and bicarbonate. The Crow Tribe could experience drawdown of groundwater in coal seam aquifers from Wyoming and Montana CBM production. The traditional pattern of natural resource consumption would be altered and therefore impacts to sacred plants and hunting and fishing are expected.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected for the CBM emphasis area. The Northern Cheyenne Reservation could experience impacts to the Tongue River and Rosebud Creek in the form of increased flow volume and changes to water quality parameters, including SAR, EC, and bicarbonate. The reservation could also experience drawdown of coal seam aquifers from CBM production in the area surrounding the reservation. The traditional pattern of natural resource consumption would be altered and therefore impacts to sacred plants and hunting and fishing are expected.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBM development activities in Wyoming, would further increase the SAR value, base flow, and other potential constituents of concern in the, Powder and Little Powder rivers. The combined decrease in water quality would necessitate the use of flow-based discharge to avoid limiting the resource for use as a source of irrigation. The resulting impacts may still impair tribal government leasing activities. This could create an environmental justice issue to tribes as described under Alternative B.

No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved. It is concluded that adverse environmental effects could occur from downstream water quality changes, resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

A review of the resource analyses for Alternative D revealed that similar potential effects would be felt as described under Alternative B for groundwater drawdown and air quality changes and under Alternative C for surface water quality but at a reduced impact because of water treatment and discharge conveyance. The same trickle-down effects would be experienced under Alternative D as described in Alternative C but, again, at a reduced level because of water treatment.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts described under Alternative C with the exception of Montana CBM surface water quality impacts. Surface water impacts would be limited to changes due to increased quantity of surface discharge but treatment prior to discharge would reduce impacts to water quality compared to Alternative C. Groundwater impacts would be the same as Alternative B.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation would be similar to impacts described under Alternative C with the exception of Montana CBM surface water quality impacts. Surface water impacts to the Tongue River and Rosebud Creek would result from increases in quantity of surface discharge but treatment prior to discharge could reduce impacts to water quality. Groundwater impacts would be the same as Alternative C.

Conclusions

The surface water quantity effects, when combined with the increases projected from similar current and planned CBM development activities in Wyoming, would be less than those described in Alternative C because of the treatment of discharge water. Water would be available for irrigators and tribal government leasing activities and would not be impaired. The drawdown of groundwater and subsequent availability would be as described in Alternative B. If the Northern Cheyenne and Crow tribes elected to develop their CBM resources, impacts would occur as described under Alternative B. No adverse human health impacts or environmental effects are foreseen from these management objectives.

Alternative E—Preferred Alternative

The impact analyses for Alternative E shows that impacts on surface water quality would be slightly altered; however, downstream uses would not be diminished nor would the State's water quality standards be exceeded. Alternative E stresses the beneficial uses of produced water from CBM wells and requires a Water Management Plan be developed that demonstrates how an operator can discharge without degrading the surface water quality before any discharge can occur. Similar potential effects would occur as described under Alternative B for groundwater drawdown and air quality changes.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the region under Alternative E with the exception of groundwater impacts. Operators are required to conduct site-specific hydrological studies prior to APD approval. If the site-specific studies determine there would be an effect to Reservation groundwater, the operator must develop and apply measures to prevent the impact of groundwater withdrawal and monitor the effectiveness of such measures. These measures would be approved by BLM in consultation with the Tribe. Furthermore, operators must modify federal CBM production if production is resulting in an effect on groundwater or CBM on the Reservation. BLM requirements could include reducing production rates, shutting in the well or wells, or providing compensation to the Tribe. The operator must correct the impact of groundwater withdrawal prior to resuming full production.

For lands under the jurisdiction of the State, the operator would be required to follow recommendations in the Technical Advisory Committee's (TAC) guidance document for meeting the requirements of the MBOGC Order No. 99-99. The order requires an evaluation of pre-development groundwater conditions, plus monitoring and evaluations, including procedures for monitoring and reporting the effects of CBM development on water users. Based on the implementation of these measures Tribal groundwater resources would be protected and potential impacts eliminated.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected for the region under Alternative E with the exception of groundwater impacts. Operators are required to conduct site-specific hydrological studies prior to APD approval. If the site-specific studies determine there would be an effect to Reservation groundwater, the operator must develop and apply measures to prevent the impact of groundwater withdrawal and monitor the effectiveness of such measures. These measures would be approved by BLM in consultation with the Tribe. Furthermore, operators must modify federal CBM production if monitoring shows production is resulting in an effect to groundwater or CBM on the Reservation. BLM requirements could include reducing production rates, shutting in the well or wells, or providing compensation to the Tribe. The operator must correct the impact of groundwater withdrawal prior to resuming full production.

For lands under the jurisdiction of the State, the operator would be required to follow recommendations in the TAC guidance document for meeting the requirements of the MBOGC Order No. 99-99. The order requires an evaluation of pre-development groundwater conditions, plus monitoring and evaluations, including procedures for monitoring and reporting the effects of CBM development on water users. Based on the implementation of these measures, Tribal groundwater resources would be protected and potential impacts eliminated.

Surface water impacts on the Tongue River and Rosebud Creek would also be reduced. The surface water quality in these two waterbodies would be slightly altered; however, downstream uses would not be diminished nor would the proposed Northern Cheyenne water quality standards be exceeded.

With regards to air quality, operators would be required to provide the information necessary for BLM to conduct an analysis of air quality impacts for all relevant parameters when submitting their exploration APDs or field development project plans. BLM would use the information to determine the individual and cumulative impact on the Reservations' air quality, disclose the analysis results in the appropriate NEPA document, and consult with the Tribes when the analysis shows impacts from a specific drilling or development proposal.

Approval of exploration APDs and field development plans, and the air quality new source review process would include conditions to prevent violations of applicable air quality laws, regulations, and standards. Mitigating measures may include surfacing roads and well locations, applying dust suppressants, requiring operators to develop and enforce speed limits on project roads, minimizing construction of roads, requiring use of natural gas-fired and electric compressors, and optimizing the number of wells connected to one compressor.

Operators near the Reservation may be required to restrict the timing or location of CBM development if monitoring or modeling by the air quality regulatory authority finds their CBM development is causing or threatening to cause non-compliance with applicable local, state, tribal, and federal air quality laws, regulations, standards, and implementation plans.

To protect important hunting, fishing, and plant gathering sites, the BLM would require operators in the area east of the Tongue River between Ashland and Birney to inventory BLM lands for traditional plant gathering sites near the proposed drilling locations. APD approvals may include avoidance or timing restrictions to prevent impacts to identified important hunting, fishing, and plant gathering sites depending on the developments' location. These measures would prevent potential impacts to subsistence living methods for tribal members. Migratory paths traditionally used by game to cross the Northern Cheyenne Reservation would be monitored as part of the Wildlife Monitoring and Protection Plan. If these impacts to migration routes result in a reduction of available game measures would be developed in consultation with the Tribe to provide for wildlife migration.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBM development activities in Wyoming, would be less then those described in Alternative C. Water would be available for irrigators and tribal government water leasing activities would not be impaired. The groundwater would be protected as described in the Northern Cheyenne Mitigation Appendix.

If the Northern Cheyenne and Crow tribes elected to develop their CBM resources, impacts as described under Alternative B above would occur.

No adverse human health or environmental effects are anticipated from this alternative.

Soils

Soils
Montana has a wide mix of geologic parent material, which produces a vast array of different soil types

Alternative A
No Action (Existing CBM Management)

- There would be minor occurrences of soil erosion, runoff, and sedimentation, mostly during construction activities.
- Approximately 1,500 acres would be disturbed short term during CBM exploration and construction activities.
- 500 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- CBM development would result in 55,400 acres being disturbed.
- 32,950 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.
- No impacts would occur to soils from CBM waters.

Alternative C
Emphasize CBM Development

- CBM development activities would disturb 70,000 acres.
- Surface discharge and irrigation of produced water could result in detrimental impacts to soils.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Impacts would be similar to Alternative B with the exception that produced water would be treated prior to discharge onto the surface and not injected.
- More water would be available for irrigation of agricultural land.

Alternative E
Preferred CBM Development Alternative

- Impacts would be similar to Alternative B. There would be a slight increase in the level of disturbance due to the increased use of impoundments to contain produced water.
- Produced water would be available for beneficial use, including irrigation.

Assumptions

Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. This analysis is focused on the CBM emphasis area, but can be used by inference on similar areas in Montana. A more detailed discussion of soils is presented in the *Soils Technical Report* (ALL 2001a).

Impacts From Management Common to All Alternatives

Impacts on soils would occur from various activities during the exploration, construction, operation, and abandonment of conventional oil and gas wells developed resulting in a loss of either soil resources or soil productivity. These impacts would include soil compaction under disturbed areas such as well sites and lease access roads, soil erosion in disturbed areas, and chemical impacts from spills of liquids. Some impacts would be unavoidable, such as those resulting from the construction of well sites. Other impacts would be mitigated by standard oil field practices, such as the use of berms around production facilities. Short-term impacts would occur typically during construction phases, including reclamation of construction sites.

Soils disturbed by the building of access roads, drill pads, and pipelines would be prone to accelerated erosion because of the removal of protective vegetation and litter cover during construction activities. This protective cover would bind the soil, provide desirable surface texture for infiltration of water and air, and protect the surface from water and wind erosion. Accelerated soil erosion would occur during the production phase in high traffic areas of the well pad or along access roads or in portions of the well pad that have not been properly graded. In areas where soils have high to severe erosion potential and are unstabilized, disturbance would result in accelerated erosion to the extent that damage to facilities and roadways may occur. Wind and water erosion on bare soil surfaces would cause more sedimentation in streams from runoff following rainfall or snowmelt.

Impacts would be greatest on shallow soils of low productivity and on soils on moderately sloping to steep landscapes. Project activities would have minimal effect on slope stability because surface disturbance on slopes in excess of 30 percent would be avoided where possible. Where such disturbances cannot be avoided, mitigative measures required by MBOGC and BLM through the APD authorization process would be implemented to reduce erosion and protect watershed resources. BLM and TLMD lease stipulations would also be used to mitigate soil erosion. Eastern Montana suffers from excessive wind erosion primarily from dry soil, sparse vegetative cover, and erodible soils.

Drilling activity-especially equipment transport-would cause soil compaction. The degree of compaction would be influenced by soil texture, moisture content, organic matter, and soil structure. Soils with a mixture of sand, silt, and clay compacts more than a soil with more uniform particle size. Coarse-textured sandy soils generally would be more compactable than fine-grained soils. Soil moisture would be the most critical factor in compaction. At field capacity, which is the amount of soil moisture remaining after a soil mass is saturated and allowed to drain freely for 24 hours, sufficient water remains in the pores to provide particle-to-particle lubrication and maximum compaction potential under load. Thus, moist but not wet soils would be most susceptible to compaction.

Organic matter such as roots and humus would help reduce soil compaction. In general, the greater the organic matter content, the less compaction. Compaction would severely affect plant growth by inhibiting root penetration, limiting oxygen and carbon dioxide exchange between the root zone and the atmosphere, and severely limiting the rate of water infiltration into the soil. Compaction of soils would inhibit reclamation and natural revegetation of disturbed areas. Loss of topsoil and a decrease in soil productivity from soil layer mixing and compaction would impact the natural vegetation supported in the area, which in turn may affect forage and habitat for wildlife and livestock. The use of off-road vehicles and heavy equipment would cause soil compaction, which will lead to increased surface runoff and subsequent erosion. Effects will be most severe when off-road vehicles and heavy equipment are used during moist and wet soils conditions.

With development, the potential for impacts to soil from drilling and produced fluids would increase. Soil contamination from conventional oil and gas development in Montana would result mainly from leaking and improperly reclaimed reserve/brine pits. Produced hydrocarbons and fuel spills would occasionally cause impacts. Spills generally would not be large and the materials would be relatively immobile. Toxic and saline concentrations from the spilled fluids would be capable of sterilizing the soil.

Construction disturbances from conventional oil and gas production would lead to the disturbance of approximately 12,650 acres (9,817.5 acres of BLM lands and 2,832.5 acres of state lands) during the next 20 years. Revegetating parts of the well pads during production would reduce the area of disturbance to 4,600 acres. Most of these acres would be remediated after the hydrocarbons have been produced.

The area would be reclaimed as prescribed by an approved reclamation plan that includes revegetation to reduce soil erosion. Most soil disturbances and related erosion would begin to be mitigated within 20 to 25 days after drilling the well. Exceptions would be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills or site contamination have occurred. These sites may take longer to remediate because special erosion control seeding or remediation measures may be necessary to achieve successful reclamation. These impacts may result in a loss of either soil resources or soil productivity.

Saline water would have a more persistent and detrimental effect on soil productivity. There would be some loss of soil through erosion as a result of surface disturbance, but this would be minimized with an approved surface use plan.

Additional disturbances would occur from coal mining in the CBM emphasis area, which is estimated at a total of 49,500 acres.

Prime Farmland

If prime farmland exists on federal or state surface where CBM development is proposed, the same type of reclamation plan is developed for it as with all such proposals. A difference would be that more topsoil probably would be available for reclamation purposes on a prime farmland site and would be identified in the reclamation plan prior to development.

If the site proposed for development were private surface, then the reclamation plan would be developed in consultation with and according to the wishes of the private landowner. Most likely, the reclamation plan on Federal versus state and private surface would be very similar.

No prime farmlands are known to exist on the federal surface. Privately owned prime farmlands over federal and state leases that are impacted by roads or site development would be reclaimed in accordance with consultation with the private surface owner. This situation would be same for all alternatives.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Impacts on soils may occur from various activities during the exploration, construction, operation, and abandonment of CBM wells developed for the project and may result in a loss of either soil resources or soil productivity. The primary concerns include increased soil erosion, loss of topsoil, mixing of soil horizons, compaction, and contamination of soils from various pollutants. These impacts may result in a loss of either soil resources or soil productivity.

Under this alternative, all CBM water on BLM-administered land would be contained or beneficially used at the well site, while all CBM water on private lands would be discharged under the existing MPDES permit into the Tongue River (up to 1,600 gpm), impounded, or used for dust control at on-site coal mines.

Exploration

Under Alternative A for BLM lands, approximately 400 acres would be disturbed for exploratory wells. On state and private lands, approximately 275 acres would be disturbed during exploration. All produced CBM water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications.

Production

There will be no CBM production on BLM lands and therefore no impacts from production. Only state and private lands will have CBM production. During the construction of the well sites, access roads, utilities, and other facilities, 812 acres of soils will be disturbed. Revegetating parts of the well pads during production would reduce the state and private soil disturbances to 500 acres. Production water may be discharged to surface waters in accordance with the existing MPDES Discharge Permit that allows discharge up to the rate of 1,600 gpm into the Tongue River. This small increase in flow volume is not considered sufficient to cause added erosion to stream banks or streambeds. Produced water may also be used beneficially by industry and landowners, or stored in impoundments onsite. If the quality of the water were acceptable (not too high in SAR or salinity), there would be little or no additional impacts to soils from land application. If the quality of land-applied water were detrimental, further mitigation measures would need to be implemented to reduce the impacts to soils (ALL 2001a).

Abandonment

After reclaiming the exploratory wells, there will be 500 acres of soil disturbed long-term-all on state and private lands. The area will be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be stabilized by vegetative cover and erosion eliminated within 2 to 5 years following the beginning of reclamation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills or site contamination have occurred. These sites may take longer to remediate because special erosion control seeding or remediation measures may be necessary to achieve successful reclamation.

There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan. Soil beneath unlined surface impoundments would also require extensive reclamation because of accumulation of sodium during infiltration of water. The soils structure could be damaged severely, plant growth would be minimal, and accumulation of salt in the soils would likely lead to the soil being removed and disposed.

Crow Reservation

There would be no impacts to the soils on the Crow Reservation from regional CBM development.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation soils from regional CBM development.

Conclusion

During the next 20 years, disturbances from limited CBM development and exploration, conventional oil and gas development, coal mining, and other projects considered under the cumulative effects analysis would result in the disturbance of about 38,500 acres of soil. These disturbances would be reduced to about 30,500 acres during the production phase of CBM, conventional oil and gas activities, and coal mining.

After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible, and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff, and sedimentation, mostly during construction activities. If the qualities of land-applied or impounded waters were acceptable, there would be little or no impacts to soils; but if water quality is detrimental, additional mitigation measures would need to be implemented.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Impacts to soils would be reduced under this alternative by requiring transportation corridors; using a single trench for utilities and piping; using multiple completions per well bore and directional drilling; using temporary tank storage and injection of all produced CBM water; and rehabilitating new roads at the end of the well lifetime. All of these would help to minimize the area of surface disturbances, which would be up to a 35 percent or higher reduction in soil disturbances.

Exploration

Under this alternative, approximately 850 acres of BLM lands would be disturbed for exploratory wells. On state and private lands, approximately 1,000 acres would be disturbed during exploration. All produced CBM water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications. Losses from exploration would be mostly temporary and would be reclaimed after exploration activities cease.

Production

During the construction of the well sites, access roads, utilities, and other facilities, 25,600 acres of BLM soils and 29,750 acres of state and private soils will be disturbed. Revegetating parts of the well pads during production would reduce the BLM soil disturbances to 15,250 acres and state and private soil disturbances to 17,700 acres. Production water will be injected; therefore, no impacts will be made to soils from CBM waters.

Abandonment

Reclaiming all of the exploratory wells would provide vegetation cover to 1,850 acres of disturbed soils. Additional reclamation activities at the production wells and utility right-of-ways (ROWs) would further establish vegetation cover to these previously disturbed soils. The disturbed areas would be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be recovered and erosion halted within 2 to 5 years, following the beginning of reclamation.. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils). There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan.

Crow Reservation

There are no Tribal sponsored CBM developments anticipated for the reservation; however, there is the possibility of on-reservation fee or private lands being developed in small pockets. These small on-reservation developments are expected to impact the soils in proximity to the wells and associate infrastructure in a similar fashion as describe above in general for Alternative B.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation soils from regional CBM development. It is not anticipated that there would be any Tribal sponsored CBM development on the reservation nor areas of fee or private development.

Conclusion

During the next 20 years, disturbances from CBM development, conventional oil and gas development, coal mining, and other projects considered under the cumulative effects analysis would result in the disturbance of about 102,300 acres of soil. These disturbances would be reduced to about 81,000 acres during the production phase of CBM, conventional oil and gas activities, and coal mining. After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff, and sedimentation, mostly during construction activities.

Development of the Crow and Northern Cheyenne reservations would disturb an initial 24,200 acres or 12,100 acres per reservation. Following the same reclamation measures as commercial CBM development, the disturbances would be reduced by nearly 10,000 acres. Each reservation would have a residual 7,200 acres of disturbed soils around well pads, access roads, utility corridors, and water management facilities.

Alternative C—Emphasize CBM Development

Under this alternative, impacts on soils would be similar to Alternative B with the following exceptions:

- Untreated CBM discharge water could be used for land application
- The discharge of produced water to the ground surface would increase erosion
- There would be a 35 percent increase in impacted soils due to specific management practices for transportation routes

The long-term impacts of using CBM water or diluted discharge water for agricultural purposes include crop effects, farming practice changes, irrigation management, and direct effects to soils. Based on the generally fine texture of the surface soils (clayey) in the emphasis area, much of the soil would likely be susceptible to increasing sodicity when irrigated or land applied with water having a high SAR (generally greater than 3 for some soils and greater than 12 for others). If sodic water is applied to these soils, the probability of soil dispersion (deflocculation) is high, causing infiltration and drainage decreases. The long-term consequence is an anaerobic, waterlogged, saline/sodic soil, which would be difficult to reclaim. Those soils with a coarser texture (sandy to loamy) and good internal drainage will be the least susceptible to increasing sodicity and salinity.

Dispersed soil would also be subject to accelerated erosion leading to gullying, increased sedimentation, and harm to riparian vegetation and aquatic habitats. The native species composition in these effected areas also will change. CBM water discharge will have the cumulative effect of encouraging the establishment and proliferation of non-native and noxious weed species. As noted in the *Soils Technical Report* (ALL 2001a), there are fewer irrigated than non-irrigated acres along the Tongue and Powder Rivers, which, based on the RFD, is where a majority of the potential CBM activity would reside. However, if adequate water and suitable agricultural soils were available in areas adjacent to production, more irrigated land would be available for production and use.

The use of high salinity/sodium CBM water may have long-term effects on crops, limiting crops to those that are more salt tolerant. Additional irrigation water would be required for leaching to ensure salts are moved out of the root zone. Increasing the frequency of irrigation may also need to be implemented to maintain soil water content and to decrease the effects of applying saline water (lower water-holding capacity and higher salinity levels). These increases in irrigation water amounts would lead to producers having to file for additional water rights or finding other sources of lower salinity water for leaching, as well as a potential for more saline seeps in areas irrigated with CBM water. The *Soils Technical Report* (ALL 2001a) discusses the impacts of discharging CBM waters to soils in more detail.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except water generated by testing CBM wells could be discharged to surface waters and the land surface-with impacts as discussed above.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except untreated water generated during production could be discharged to surface water with appropriate permits and to the land surface at the well pad. Impacts of land application of CBM waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would be rehabilitated and closed. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn Rivers. Impacts associated with on-reservation fee lands would be similar to those described in general for Alternative B. In addition, impacts associated with direct discharge practices as described for Alternative C would be expected for these wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be expected to soils being irrigated with waters from the Tongue River and Rosebud Creek. Since these waterbodies would experience increases in their SAR and EC values, it is conceivable that Tribal irrigators would also experience the types of soil impacts described in general for Alternative C. Soils impacts from Tribal sponsored development on the reservation are not anticipated for this alternative.

Conclusion

Cumulative impacts would be similar to Alternative B, except that the surface disturbances would increase by up to 35 percent and surface discharge and irrigation of produced water would increase detrimental impacts to soils. Saline water has a more persistent and detrimental effect on soil productivity, especially when immediate mitigative measures are not followed for cleanup. Cumulative disturbances from all regional projects would result in the disruption of about 134,750 short-term acres of soil. These disturbances would be reduced to about 102,300 acres during the production phase of CBM, conventional oil and gas activities, and coal mining.

One advantageous side effect would be that more water would be available for irrigation if acceptable agricultural land is available, but if acceptable qualities of water are not used, there could be an increased detrimental impact on additional soils.

Soil disturbance levels on the Crow and Northern Cheyenne Reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres); however, they are expected to be somewhat increased do to the surface discharge of production water.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Under this alternative, impacts on soils would be similar to Alternative B except that produced water would be treated prior to discharge onto the surface or for irrigation, and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except that water generated by testing CBM wells would be treated prior to discharge to surface waters and the land surface (instead of injection), which lessens the impacts caused by application of high-SAR water to soils.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except water generated during production would be treated prior to discharge to the land surface and to surface water-with appropriate permits. Impacts of the land application of CBM waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would remain open or closed at surface owner's discretion. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The only soils impacted on the Crow Reservation would be from on-reservation fee developments similar to those previously described in Alternative B.

Northern Cheyenne Reservation

There would be no impacts to soils on the Northern Cheyenne Reservation from regional CBM development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted, since production water will be treated prior to discharge.

Conclusion

Cumulative impacts would be similar to Alternative B with the exception that produced water would be treated prior to discharge onto the surface and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.

Soils disturbance levels on the Crow and Northern Cheyenne Reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres).

Alternative E—Preferred Alternative

Under this alternative, impacts on soils would be similar to Alternative B except that produced water would be managed per a site-specific Water Management Plan with first priority being beneficial use of produced water; impoundments designed to minimize or mitigated impacts to soil, water and vegetation; an option for injection of CBM water; and no degradation of a watershed. All of these factors would reduce the detrimental impacts caused by application of high-SAR water to soils. There would be a 35 percent increase in impacted soils over alternatives B and D due to specific management practices for transportation routes-this percent will vary depending on site-specific Project Plans for ROWs agreed upon with the surface owners.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except that water generated by testing CBM wells would not be allowed to degrade the watershed, which lessens the impacts caused by application of high-SAR water to soils.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except water generated during production would be beneficially used, stored in impoundments, or discharged without impacts to the watershed. Impacts of the land application of CBM waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would remain open or closed at surface owner's discretion. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn Rivers. Impacts associated with on-reservation fee lands would be similar to those described in general for Alternative B.

Northern Cheyenne Reservation

There would be no impacts to soils on the Northern Cheyenne Reservation from regional CBM development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted, since only slight alterations in surface water quality are anticipated.

Conclusion

Cumulative impacts would be similar to Alternative B with the exception that produced water would be managed per a site-specific Water Management Plan that would be geared toward minimizing impacts to soil, water and vegetation, and surface owners would have more input in the Project Plan for the transportation corridors. Cumulative disturbances from all regional projects would result in the disruption of about 132,000 short-term acres of soil. These disturbances would be reduced to about 92,200 acres during the production phase of CBM, conventional oil and gas activities, and coal mining. Soils disturbance levels on the Crow and Northern Cheyenne Reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres). It is anticipated the Tribes would manage or require their produced water to be managed in a similar manner to what will be required of off-reservation commercial CBM developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

Solid and Hazardous Waste

Solid and Hazardous Wastes
Solid and hazardous wastes are under the jurisdiction of the MDEQ for RCRA wastes, MBOGC for RCRA exempt wastes, and the EPA for wastes generated on tribal lands

Alternative A
No Action (Existing CBM Management)

- Typical solid waste refuse can be disposed of in local landfills.
- Drilling mud and cuttings can be disposed of onsite with the landowner's permission.
- Minor impacts would also occur from the use of pesticides and herbicides during access and construction activities

Alternatives B, C, D, and E

- Impacts for Alternative B, C, D, and E would include increased quantities of waste requiring onsite disposal or transport to commercial landfills.
- Oil and gas developers are responsible for any damages to property, real or personal, resulting from the lack of ordinary care during operations. Operators are required to maintain SPCC plans and immediately remove and spilled or unused non-exempt wastes from the sites.
- No long term impacts to private, state or federal lands would occur from waste products associated with CBM development.

Assumptions

All wastes generated by oil and gas operations including CBM that are Resource Conservation and Recovery Act of 1976 (RCRA)-classified wastes, such as paint wastes or RCRA-exempt wastes such as drilling wastes, would be disposed of in accordance with regulations. Any release of a hazardous material would be reported in a timely manner to the relevant agency or to the BLM via a Report of Undesirable Event (NTL-3A). Any release of a CERCLA substance would be reported in accordance with regulations.

Impacts From Management Common to All Alternatives

Typical solid waste refuse would be generated by oil and gas drilling operations and can be disposed of in local landfills. The largest volume of waste generated from drilling activities would be from the drilling mud and cuttings generated. These drilling wastes would be exempt from RCRA and are considered non-hazardous. Drilling mud containing less than 15,000 mg/l TDS can be disposed of on-site with the landowner's permission. The amount of waste generated should not exasperate the landfills in the area. Other impacts would result from spills of waste during maintenance activities, including waste oil from generators, paint waste from construction activities and other solid wastes from construction activities. Impacts would also occur from the use of pesticides and herbicides during access and construction activities.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Impacts from Alternative A would be similar to the impacts described in the previous *Impacts From Management Common to All Alternatives* section . The solid and hazardous waste generated during CBM exploration, production, and abandonment would be similar to conventional oil and gas. The drilling muds would be of lesser quantity because of the shallow drilling depths for CBM wells compared to conventional oil and gas.

Crow Reservation

There are no CBM developments anticipated on Tribal Lands under this alternative, and therefore no impacts are expected. Furthermore, there would be no impacts on the reservation from the use of solid and hazardous materials on off-reservation CBM operations.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation from solid or hazardous material use on off-reservation CBM developments.

Conclusion

The cumulative impacts of this alternative would include the solid and hazardous waste generated from conventional oil and gas, surface mining activities, and CBM development. These other activities would result in increased production of both solid and hazardous waste that occur as part of general operation activities. Mitigation would include the disposal of all wastes in accordance with applicable federal, state and local regulations.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

The impacts from this alternative would be similar to the impacts under Alternative A. However, CBM development would result in larger quantities of solid and hazardous waste production.

Crow Reservation

There are no Tribal sponsored CBM developments anticipated on the reservation under this alternative; however, fee lands on the reservation could have private CBM developments. These small developments are expected to generate solid and hazardous wastes in the same proportions as their off-reservation counterparts. These wastes will need to be disposed of in accordance with applicable Tribal and EPA regulations.

There would be no impacts on the reservation from the use of solid and hazardous materials on off-reservation CBM operations.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation from solid or hazardous material use on off-reservation CBM developments.

Conclusion

The cumulative impacts from this alternative would be similar to Alternative A. However, the increased scale of CBM development, including the potential development of CBM on the Crow and Northern Cheyenne Reservations and USFS lands, would increase the volume of solid and hazardous waste generated. The increased volume of solid and hazardous wastes would result in local landfills reaching capacity sooner, which would generate the need for the construction of new landfills that would further disturb lands. The additional trucks used for hauling waste would increase traffic and air emissions.

Wastes generated on the Reservations from Tribal development would need to be disposed of following EPA regulations and Tribal laws, if any. This may necessitate the construction of a non-hazardous landfill for the acceptance of solid wastes from the RFFA estimate of 4,000 wells per reservation.

Alternative C—Emphasize CBM Development

The impacts under Alternative C would be the same as for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The impacts under Alternative D would be the same as for Alternative B.

Alternative E—Preferred Alternative

The impacts under Alternative E would be the same as for Alternative B.

Vegetation

Vegetation

Emphasis area acreage by land classifications:

- *Grasslands, 3.55 million*
- *Shrublands, 1.8 million*
- *Forests, 1.36 million*
- *Riparian Areas,378,000*
- *Barren Lands, 372,000*

87,400 acres currently contain non-native plants and noxious weeds

Alternative A
No Action (Existing CBM Management)

- 1,144 acres of native habitat would be impacted under this Alternative, more than half (580 acres) in grasslands.
- On non-federal land, Ute ladies'-tresses could be slightly impacted by disturbances

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- 55,400 acres of native habitat could be impacted under this Alternative, more than half (21,450 acres) in grasslands.
- On non-federal land, Ute ladies'-tresses could be impacted by disturbances

Alternative C
Emphasize CBM Development

- 70,000 acres of native habitat could be impacted under this Alternative, more than half (27,300 acres) in grasslands.
- If SAR values exceed 10 in water, riparian vegetation would be impacted, affecting as many as 3,535 acres of riparian habitat.
- On non-federal land, Ute ladies'-tresses could be impacted by disturbance, SAR values, and water level changes, particularly inundation.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- 55,400 acres of native habitat could be impacted under this Alternative, more than half (21,450 acres) in grasslands.
- Hydrology changes may affect as much as 2,776 acres of riparian habitat due to increased stream flow.
- On non-federal land, Ute ladies'-tresses could be impacted by disturbance and water level changes, particularly inundation.

Alternative E
Preferred CBM Development Alternative

- Impacts would be similar to those for Alternative D, however no riparian habitat would be affected.

Assumptions

The Miles City BLM *Seeding* Policy, dated October 27, 1999(c), lists guidelines for seeding practices by typical Montana soil types; it is assumed this policy will be implemented where appropriate. Recommended species are identified for quick coverage of disturbed soils, to discourage invasion of noxious weeds, and to attenuate soil erosion. Reclamation work will be considered complete when the disturbed area is stabilized, soil erosion is controlled, and at least 60 percent of the disturbed surface is covered with the prescribed vegetation.

Under all alternatives, most riparian areas and certain wildlife habitats (see the Wildlife section) are protected from direct impact under current stipulations on BLM land that restrict surface occupancy but not road crossings (BLM 1994).

Surveys to determine the presence of federally listed species would occur on BLM-managed land or mineral estate. The APD requires that BLM determine if the proposed development plan would affect any species listed as threatened or endangered.

Formal consultation with the FWS would occur for site-specific federal CBM projects developed under this EIS if a federally listed threatened and endangered (T&E) species or candidate or proposed species may be affected. Section 7(a) of the Endangered Species Act (ESA) requires that federal actions "are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or undesirable modification of its habitat." BLM policy for proposed and candidate species is to avoid actions that would jeopardize a species and require formal listing under the ESA.

Special management attention is given by state and federal agencies to state, BLM, and USFS Species of Concern. Agencies approve actions to avoid areas that would jeopardize a species and thereby require federal protection in the future.

The MBOGC environmental review includes an assessment of potential impacts to vegetation during construction and drilling operations. MBOGC policies require the operators to minimize the size of drilling pads and require complete restoration of the area once operations are complete (Administrative Rules of Montana [ARM] 36.22). Mitigation plans are included with the environmental review to notify operators of requirements prior to construction.

For federal actions, FWS is required to provide consultation to federal agencies. They do not have this same requirement for state agencies. Even if a state agency requests a consultation, the FWS does not have the authority to provide it. If a state or private CBM project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the federal agency.

The FWS would be consulted under Section 10 of the ESA if a federally related action is triggered.

On BLM lands, where specific stipulations do not exist or do not currently apply, there is a presumption that impacts on T&E plant species would be avoided through development and observation of specific conservation measures developed through consultation with FWS intended to avoid impacts on T&E species as required under the ESA.

Impacts on T&E plants on non-federal lands are less likely to be avoided through conservation measures because they are not protected.

Species of concern on all lands would likely receive a relatively high degree of protection at a regional scale because federal and state agencies are committed to avoiding measures that would require listing protection under ESA. However, this would likely not protect all individuals or perhaps some populations within the region.

BLM field clearances and other required pre-exploration activities developed through this EIS process, and which are intended to identify site-specific occurrence of T&E species, would be conducted as specified, leading to knowledge of specific resources and implementation of appropriate avoidance actions and conservation measures discussed above.

Federal and state agency monitoring of exploration, development, and production activities are assumed to be adequate to ensure all lease conditions and ESA requirements are followed.

Preventing the spread of noxious weeds is easier, more successful, and less costly and time-consuming than reclamation or mitigation. Stipulations for current exploration authorizations within the Billings and Powder River RMP areas cover weed management and riparian/wetland management (BLM 1995). Under these stipulations, all categories of noxious weeds must be managed.

Stipulations and options for containment of noxious weeds on state lands are listed in the Minerals Appendix, Table MIN-5.

The BLM has co-developed an action plan for weed containment and eradication practices that will be implemented for all alternatives (BLM 1996). Pertinent sections of Appendix 3 from that document are reproduced in Table 4-51. The action plan applies to the State of Montana's list of weed species of concern (see Table VEG-7, Vegetation Appendix). This list includes species that are considered to be highly invasive and disruptive to natural systems. It is assumed that these weed-prevention activities will be required for CBM exploratory and production sites, roadways, pipelines, utility corridors, and other disturbed sites on BLM land except as specifically noted for some of the alternatives.

Wetlands are legally protected by Section 404 of the Clean Water Act. Therefore, all such wetlands must be surveyed and delineated before any drilling can take place. If wetlands will be impacted by proposed drilling or road alignments, they must be avoided or mitigation measures must be developed to compensate for impact. This compensation may include the development of replacement wetlands. In some instances, Nationwide 404 Permits (NWP) may apply to CBM projects. Applicable NWPs include NWP 12 (Utility Line Activities) and NWP 14 (Linear Transportation Crossings). The producers must meet all terms and conditions of the NWP for it to apply.

On private lands, it is assumed that the private landowner will negotiate with the producer before exploration and development and come to an agreement as to what measures the producer will instigate for weed control, site restoration, and as to what criteria constitutes successful site restoration and proper weed control.

Impacts From Management Common to All Alternatives

Construction of facilities and roads would cause the primary effects on vegetation. For a developed well, a site about 40 percent of the original drill site would remain disturbed for the life of the well (20 years). However, unsuccessful exploratory sites would be reclaimed. Reclamation generally includes spreading topsoil and reseeding according to the landowner's request (private land) or the BLM *Seeding Policy* (BLM 1999c). The BLM *Seeding Policy* and site restoration stipulations do not extend beyond the borders of their lands. Therefore, it is essential that private landholders negotiate with the producer prior to exploration and development on private lands and come to an agreement as to what measures the producer must instigate for weed control and site restoration. This includes what criteria will be used to assess adequate site restoration and proper weed

TABLE 4-51
EXAMPLE: PARTIAL BLM DISTRICT-WIDE WEED PREVENTION SCHEDULE

Prevention Activity	When	Who Is Responsible
Clean off-road equipment with powerwash or high-pressure to remove all mud, dirt, and plant parts before moving into relatively weed-free areas.	All Year	Equipment Operators; Fire Crew
Re-establish vegetation on all disturbed soil from construction, reconstruction, and maintenance activities.	Spring/Fall	Project Proponent
Inspect gravel pits and fill sources to identify weed-free sources. Gravel and fill to be used in relatively weed-free areas must come from weed-free sources.	Spring/Summer	Surface Protection Specialist; Equipment Operator
Retain bonds (for mineral activity) for weed control until the site is returned to desired vegetative conditions.	All Year	Mineral Specialist
Include weed-risk considerations for environmental analysis for habitat improvement projects.	All Year	Wildlife Biologist
Provide weed identification training for field-going employees and managers.	Winter/Summer	Weed Coordinator
Distribute public information/brochures.	Spring/Summer	Public Affairs Officer
Include weed risk factors and weed prevention considerations in Resource Advisor (Environmental Specialist) duties on all Incident Overhead Teams and Fire Rehabilitation Teams.	Summer	Resource Advisor

Note: Revised from BLM 1996.

control. Pre-development agreements are the responsibility of the landowner.

Small areas of vegetation would be lost to roads and drill sites for each well. Dust and vehicle emissions could reduce growth of vegetation adjacent to roads and drill sites. If disturbed areas are prepared and seeded properly, reclamation may further reduce the effects of dust. The effects of drilling on vegetation would be of particular concern under the following circumstances:

- When drill sites or roads are proposed within or cross riparian areas, wooded drainages, or wetlands
- Where drill sites or roads would cause sedimentation or channel down-cutting in riparian areas
- When drill sites or roads would be in areas that contain populations of special status plants
- Where operations could spread or encourage the growth of weeds
- In case of reserve pit leakage
- In the event of blowouts or wildfire

Drilling sometimes may occur in or near areas that support riparian vegetation or special status plants. If located in or at the head of drainages, drill sites and access roads can add sediment to streams and wetlands. Channel degradation can also occur. Heavy sediment loads or severe degradation would affect riparian vegetation. Roads and facilities are supposed to avoid sensitive areas “to the extent practicable.”

Therefore many, but not all, sensitive areas such as riparian areas and wetlands would be avoided.

Soil disturbance associated with drilling can cause weeds to spread. Of even greater concern is the long-distance transport of certain weed species by drilling equipment and vehicles. Weed spread is reduced if disturbed areas are re-vegetated during the season of disturbance or the next growing season as recommended (Table 4-51). All well drilling operations are covered by the County Noxious Weed Control Act, which holds landowners responsible for weed control. The contribution of oil and gas drilling to weed spread is comparable to other types of construction.

Because of the legal restrictions placed on the harm or take of federally listed species, direct impacts to these listed species would not occur on federal land. Indirect impacts to federally listed species such as habitat destruction will be addressed on a species-by-species basis. Federally listed plant species on non-federal land ownership may be impacted through conventional oil and gas activities because threatened and endangered plants on private lands are not covered by the ESA.

Mitigation

Site clearance surveys would be conducted prior to disturbance. Where necessary, operator plans would be adjusted as appropriate to avoid impacts to federally listed species.

Review of Montana Natural Heritage Program (NHP) data on a case-by-case basis for Trust Land Management Division (TLMD) Montana Oil and Gas lease sale may indicate areas of plant locations on state lands. A vegetation survey stipulation is used on the lease. For site-specific proposals, the TLMD field staff, may consult with DNRC biologist and Montana-NHP botanists as needed. The TLMD stipulation (see Table MIN-5), reads as follows: "Plant species of concern have been identified on or near this tract. A vegetation survey in areas of proposed activity will be required prior to disturbance. Identified rare plant species will be avoided, unless authorized by the TLMD."

Conclusions

There would be no impact on federal land to federally listed species. There may be impacts to federally listed plants on non-federal land and to other species of concern.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Previous authorizations have allowed selected CBM exploration in the Powder River and Billings RMP areas as well as selected well development and exploration on state lands.

Disturbance to vegetation is of concern because wildlife habitat and livestock production capabilities may be diminished or lost over the long-term through direct loss of vegetation (including direct loss of both plant communities and specific plant species). Indirect impacts, such as noxious weed invasion, erosion, reduced plant species diversity following reclamation, or lack of successful reclamation, could also cause vegetation loss. Under the No Action Alternative, only riparian habitat types and certain wildlife habitats (see Wildlife section) are protected under current stipulations (BLM 1995).

Direct impacts on vegetation would occur during land-disturbing activities associated with installation of exploratory or development CBM wells that remove vegetation to construct a facility (e.g., roads, drilling pads, mud pits, etc.). All direct impacts from exploratory wells are for the life of the well, then rehabilitated. Both temporary and permanent impacts would occur with installation of development wells.

DNRC, TLMD uses buffer stipulations and use of the no-surface-occupancy of navigable riverbeds and related acreage stipulation on its oil and gas leases on a case-by-case basis for protection of riparian habitat. Table 4-52 summarizes the acreage that could be potentially impacted in the two RMP areas and the three counties under state-permitting jurisdiction.

Vegetation types to be potentially impacted were determined based on the extent of each vegetation type overlying coal beds. Impacts to specific vegetation types were assigned in proportion to their total acreage within an ownership (see Table 4-52). For example, there are 1,537,000 acres of grassland in the Powder River RMP area or 40 percent of the total area. Assuming that 200 acres would be permanently disturbed in the Powder River RMP area, 80 acres (40 percent) of permanent, direct impacts would be expected to occur in grassland. If natural communities from Table 4-53 are considered, grasslands would be expected to experience the largest permanent loss (580 acres), based on occurrence. Shrubland would be the next most permanently impacted habitat

TABLE 4-52
AMOUNT OF ACREAGE WITH UNDERLYING COAL BEDS IN EACH HABITAT TYPE (BY RMP AREA AND STATE LAND)[1]

Area	Grassland	Shrubland	Forest Land	Barren Land	Riparian[2]	Agricultural or Other Land Not Included as Native Vegetation
Powder River RMP area	1,537,000 (40%)	920,000 (24%)	897,000 (23%)	210,000 (5%)	180,000(5 %)	136,685 (4%)
Billings RMP area	1,022,000 (40%)	735,000 (29%)	372,000 (15%)	87,000 (3%)	105,0002 (4%)	206,287 (8%)
MBOGC-regulated land	990,000 (56%)	152,000 (9%)	89,000 (5%)	75,000 (4%)	93,000 (5%)	359,151 (20%)

[1] Figure in parentheses indicates percentage of total acreage within the RMP area and MBOGC-regulated land.

[2] These acres are exempt from CBM development as a result of stipulations that omit this type from consideration for CBM exploration and development; they may be affected by water pollution and increased salinity.

TABLE 4-53
ACREAGE POTENTIALLY IMPACTED IN EACH HABITAT TYPE FOR ALTERNATIVE A (BY RMP AREA AND STATE-PERMITTED LAND[1])

Area	Grassland		Shrubland		Forest Land		Barren Land		Riparian		Other Areas	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Powder River RMP	80	0	48	0	46	0	10	0	10	0	8	
Billings RMP	80	0	58	0	30	0	6	0	8	0	16	
MBOGC-regulated land	420	140	68	23	38	13	30	10	38	13	150	50
Total*	**580**	**140**	**174**	**23**	**114**	**13**	**46**	**10**	**56**	**13**	**174**	**50**

*These estimates were arrived at using GIS data. Sweet Grass and Carter counties did not have enough bituminous coal beds to show up on those layers, therefore CBM well data for those two counties are not included in these estimates. The total acres of impact using GIS data are 1,393 acres. Total real impacts for all counties are estimated to be 1,488 acres.

[1] MBOGC regulated

(174 acres), followed by forest land (114 acres), barren land (46 acres), and riparian habitat (56 acres). Of the 56 permanently impacted riparian acres, 20 are on BLM land, and most are protected by stipulation during exploration.

Indirect impacts may be as important as direct impacts for plants and habitats. As noted earlier, indirect impacts would include the effects of erosion, changes in wildlife and livestock distribution, unsuccessful reclamation, riparian community changes, and the spread of noxious weeds.

Erosion from roads and drilling sites can indirectly affect vegetation from high runoff velocities scouring the plants from the site or by sediment burying the plants. The extent of this potential impact would be determined by the effectiveness of erosion-control measures and the level of enforcement of stormwater management plans. Plant community impacts would be in the same proportions as discussed under direct impacts. The basis of this analysis is formed from the assumption that installation of erosion-control procedures and effective enforcement of stormwater management plans would occur. Implementation of erosion-control measures and stormwater management plans would result in no long-term impacts from erosion. Short-term impacts are still likely to occur from thunderstorms during first few years and from 20 years of active roadbeds.

A total of 250 acres may be reclaimed following temporary disturbance at state-permitted wells. Failure to adequately restore these acres to pre-disturbance conditions would result in a loss of native habitat. Typical seeding mixes only include herbaceous species. When shrub and forest sites are impacted, there would be a loss of structure and diversity of vegetation using the current seeding mix. If reseeding is successful, it would potentially reduce noxious weed invasion, erosion, and dust through restoration of plant cover.

CBM exploration activities could result in the recruitment of noxious weeds by disturbing present vegetative cover, compacting soil, exposing mineral soil to seed fall, and aiding the migration of seeds through movement of vehicles and drilling equipment from site to site. Noxious weeds can indirectly impact native vegetation by out-competing native plants for scarce nutrient, light, and water resources, thereby displacing the native species. Sites with the greatest potential for noxious weed invasion, erosion, or difficulty in restoring to pre-disturbance vegetation are generally sites with pre-existing weed problems or drier sites, such as those designated as barren land. Noxious weeds introduced into a forest environment would be very difficult to control because of access restrictions when weeds spread into deep drainages and timbered hills where chemical control would be difficult. Control of noxious weeds is addressed under current BLM stipulations or state law. The increase in the number and potential for spread of noxious weeds with disturbance is an important consideration even at the current level of exploration and development. This concern is related to other indirect impacts, such as lack of successful reclamation and erosion.

Species of concern include federally listed T&E, and candidate species; Montana species of concern; BLM species of concern, USFS species of concern, and Montana Natural Heritage Program (MNHP) species of concern. For the state, this document addresses only those listed as category S1, which are species of extreme rarity or species for which some factor of its biology makes it especially vulnerable to extinction. The Vegetation Appendix, Table VEG-6 describes and lists all special-status species.

As discussed in the *Species of Concern* section of Chapter 3 in this EIS, there is one federally listed threatened plant species. In accordance with the ESA, this species and its habitat must be protected from possible impact by oil and gas and CBM development on federal land, but not on state or private land. Additionally, 69 species are classified as “species of special concern” by the Montana BLM, USFS, and MNHP. By policy, BLM management cannot impact these species in a way that may cause further declines in the species’ population status. This section will address federally listed plant species protected under the ESA.

Species of Concern: Federally Protected

Ute Ladies’-Tresses Orchid

This species is only known to occur in the southwestern part of the state. No development is planned for that part of the state, therefore impacts are not expected to known populations of this orchid from CBM exploration or development.

Crow Reservation

CBM development on the Crow Reservation is expected to be very limited. To the extent that it does occur, impacts to plant communities and natural vegetation would be similar to those described for private lands and would occur on a much smaller scale than on BLM or State lands.

Northern Cheyenne Reservation

CBM development on the Northern Cheyenne Reservation is expected to be very limited. A study of methane gas development on Northern Cheyenne lands concluded that it would be uneconomical (Little Coyote 2001; Herco-Hampton 1989). To the extent that it does occur, impacts to plant communities and natural vegetation would be similar to those described for private lands and would occur on a much smaller scale than on BLM or State lands.

State Species Of Concern

Direct and indirect impacts on other species of concern would be expected to some degree.

Conclusions

Up to 1,105 acres of native vegetation (excluding up to 20 riparian acres on BLM land) would be lost through CBM exploration activities and an additional 250 acres would be temporarily disturbed. Unspecified grazing impacts to native vegetation would occur if displaced animals concentrate in certain areas. Shrub, forested, and barren lands would not be adequately restored using the existing recommended seeding mix, which reseeds only grasses. For all habitats, some reclamation efforts may fail. Strict adherence to reclamation policies would result in no impact to vegetation from noxious weed infestations. However, these guidelines and regulations have been in place for many years and weeds continue to spread across central and eastern Montana. Therefore, some further infestations of noxious weeds would be expected. User-created roads would result in additional loss of vegetation and increased potential spread of noxious weeds (USDI and USDA 2001). No impacts on the Ute ladies'-tress would be expected.

Cumulative Impacts

Cumulative impacts may occur from coal mining operations. Coal mining occurs within the same area covered by this EIS. Vegetation will be destroyed within the disturbed area of a coal mine. As the mine area is reclaimed, topsoil is redeposited and reseeded to reestablish vegetation. Reseeding during reclamation activities will generally result in an increase in grasslands with less plant diversity than was present under pre-mining conditions.

About 92 percent of the coal volume located in the Powder River basin occurs within Wyoming (Ellis et al. 1999) and as many as 50,000 CBM wells may be developed in the Wyoming portion of the basin. The direct and indirect effects of Wyoming CBM development would far surpass the effects of CBM development in Montana under Alternative A because of so many wells. Some rivers entering Montana from Wyoming would be expected to have higher flows, resulting in potential erosion of wetland and riparian communities and habitat degradation.

ESA provisions applied to other projects should avoid cumulative impacts to T&E wildlife species when considered in conjunction with CBM exploration and development.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

As listed under Alternative A, four habitat types (grassland, shrubland, forest land, and barren land) will be affected in varying amounts depending on the alternative and the amount of habitat with underlying coal beds. Well development is estimated at 18,300 wells in the RFD, but only 16,470 of these will be production wells. If these wells are distributed evenly over habitats by the proportion of habitats with bituminous coal beds, a total of approximately 55,360 acres would be directly impacted by production wells and dry hole drilling. Approximately 48,864 acres would occur on land with native vegetation: 21,446 acres of grassland vegetation, 13,214 acres of shrubland, 11,680 acres of forest land, and 2,523 acres of barren land could be potentially impacted, if wells were distributed in proportion to the amount of acres in each habitat type. Direct impacts to riparian areas are similar to Alternative A.

Table 4-54 estimates the acres of direct impact for each action alternative based on information in Chapter 2. Direct vegetation loss by habitat type is assumed to be proportional to the relative amount of each habitat type shown in Table 4-53.

As discussed in the Wildlife section, water production and roads can alter the distribution of wildlife and livestock. As wildlife or livestock use is concentrated due to those factors, plant communities can be altered through overgrazing. Overgrazing tends to favor establishment and reproduction of annual and invasive plant species. These species tend to displace native plant assemblages. To the extent grazing animals concentrate in smaller areas, plant communities would change to less diverse, introduced plant communities. Most county weed control efforts focus on herbicide spraying, which reduces plant diversity even more.

TABLE 4-54
ACRES OF LAND AND LENGTH OF ROADS AND UTILITY CORRIDORS DIRECTLY IMPACTED BY NEW CBM CONSTRUCTION

	Alternative			
	B	**C**	**D**	**E**
Area disturbed per well[1, 2]	3.25 acres	4.14 acres	3.25 acres	4.14 acres
Length of roads per well[2]	0.237 miles	0.365 miles	0.237 miles	0.365 miles
Length of utility corridor per well[3]	0.734 miles	1.13 miles	0.734 miles	1.13 miles
Number of wells[2]	18,300	18,300	18,300	18,300
Total area directly disturbed[3]	55,360 acres	70,015 acres	55,360 acres	73,860 acres
Length of CBM roads per square mile[2, 4]	2.9 to 8.8 miles	3.9 to 11.9 miles	2.9 to 8.8 miles	3.9 to 11.9 miles
Total length of CBM roads[2]	6,680 miles	9,018 miles	6,680 miles	9,018 miles
Length of pipeline and utility corridors per square mile[3,4]	9.04 to 27.12 miles	12.2 to 36.61 miles	9.04 to 27.12 miles	12.2 to 36.61 miles
Total length of pipeline and utility corridors[3]	20,679 miles	27,917 miles	20,679 miles	27,917 miles

[1] The land area disturbed and the length of roads and corridors would be 27 percent greater for Alternative C than for Alternatives B and D because transportation corridors and the use of existing disturbed lands would not be required for roads and utilities under Alternatives B and D.

[2] Short-Term

[3] Long-Term

[4] Length of roads, pipelines, and utility corridors per square mile covers the range of 8 to 24 wells per square mile of land overlying 1 to 3 coal seams, respectively. At an average of 8 wells per square mile, 2,287 square miles would be impacted by intensive CBM development. At 24 wells per square mile, 762 square miles would be impacted by intensive CBM development. Additional wildlife habitat surrounding well fields would be indirectly impacted by human activities and presence.

Indirect effects include changes in wildlife and livestock distribution patterns as a result of machinery disturbance or removal of habitat.

When disturbance removes vegetative cover from soil, it is open to erosion from wind and water. Erosion from roads and drilling sites can indirectly affect vegetation from high runoff velocities scouring plants from the site or by sediment burying the plants. The extent of this potential impact would be determined by the effectiveness of erosion-control measures and the stormwater management plans. Types of plant community impacts would be in the same proportions as discussed above but on a much greater scale than for Alternative A.

Existing hydrology and riparian vegetation would not be affected by build-up of salts with this alternative because of the use of injection and holding tanks for production water. The potential for spreading noxious weeds is substantially greater than under Alternative A because 20 times as much land would be disturbed.

Species of Concern-Federally Listed Species

Direct impacts to federally protected species are prohibited by law and are the same as under Alternative A.

The potential for direct and indirect impacts on other species of concern would be much greater under this alternative because of the much larger amount of habitat that will be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads, pipelines, and utility lines. More roadways provide greater access and more potential for disturbance, poaching, or harassing of protected species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. If there were no CBM development on Tribal Lands, then there is expected to be minimal, impacts on vegetation for the reservation. If there is CBM development on the reservation, then the acres of disturbed habitat could be inferred to the reservation using the same approach used in this section.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusions

The impacts of CBM development under Alternative B would be substantially greater than under Alternative A because 20 times as many wells would be developed and 20 times as much area would be disturbed.

Reclamation after well abandonment on 44,000 acres may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Cumulative Impacts

Cumulative impacts would be the same as described for Alternative A except that Montana CBM development impacts would be greater.

Alternative C—Emphasize CBM Development

A total of approximately 70,015 acres would be directly impacted. Approximately 62,238 of this acreage would be on sites with native vegetation cover. Approximately 27,316 acres of grassland vegetation, 16,831 acres of shrubland, 14,877 acres of forest land, and 3,214 acres of barren land could be potentially impacted, if wells were distributed in proportion to the amount of acres in each habitat type. Direct impacts to riparian areas are similar to Alternative A. In addition, although no wells will be authorized in riparian areas under any alternative, the discharge of untreated water from exploration and production onto the surface could affect riparian vegetation, perhaps as much as 3,535 acres. This is the estimated average total acreage of habitat with riparian vegetation that is underlain by bituminous coal bed (BLM and state).

Indirect impacts would include the impacts noted earlier of noxious weed invasion, erosion, and changes in wildlife and livestock distribution. In addition, indirect impacts would include increased SAR and salinity levels, which could result in riparian community changes and increased erosion potential for wetland and riparian communities.

Alternative C has the greatest potential for erosion because of the increased disturbance area with no restrictions on corridors for pipelines, utilities and roadways and no requirements for directional drilling or multiple completions in a single well. The extent of erosion would be determined by the effectiveness of erosion-control measures and the stormwater management plans. This alternative will potentially increase the area of disturbance over Alternatives B or D by approximately 15,000 acres (Table 4-54). This acreage increase will increase the potential for erosion.

With discharge of the CBM water to surface drainages and streams, erosion could occur, which could damage or destroy instream and streambank riparian vegetation (Regele and Stark 2000). The erosion could result in increased sediment loads that, along with the potential high salinity and sodicity, could degrade the stream and impact riparian vegetation. Impacts of discharging CBM waters would likely be greatest in intermittent and smaller perennial drainages during low-flow periods. Releases during low-flow periods of late summer and fall would have the greatest potential to impact riparian vegetation. This is also the time when this vegetation is naturally stressed because of low water. The potential for impacts on riparian vegetation exists along drainages and streams throughout the CBM development area.

CBM groundwater discharge has an SAR capable of killing vegetation (Regele and Stark 2000). Plant growth is affected in sodic soils due to decreased soil permeability, increased pH (which lowers nutrient availability), and accumulation of certain elements (sodium, boron, and molybdenum) at a level toxic to plants. Because of the typically low flows of the CBM wells (approximately 5 to 10 gallons per minute), it is likely that these SAR impacts would be localized in the vicinity of the discharge, unless flow were collected from a large number of wells.

Species of concern have a higher potential for direct and indirect impacts compared to Alternative B because of more surface disturbance.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusion

Reclamation of vegetation after well abandonment may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Localized increases in salinity and SAR values may be the most important aspect of this alternative. Salinity can have long-term effects on vegetation, including death of riparian vegetation and concentrations of salt in riparian soils. Soil impacts may last long after a given project site has been abandoned. Increased SAR values may prevent nonhydrophytic reclamation vegetation from succeeding. Increased roads result in more land being disturbed, more wildlife and livestock forage will being removed, and more area for noxious weed invasion being present.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads, and/or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Cumulative Impacts

The types of cumulative impacts are the same as discussed under Alternative A. Disturbed habitat quantities would be similar to those described in Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts

Impacts on habitat types under this alternative would be the same as Alternative B except for the potential for riparian impacts. Although no wells will be authorized in riparian areas on BLM land under any alternative, the discharge of water from exploration and production onto the surface could create riparian areas that will be abandoned and could affect the hydrology of current riparian areas, perhaps as much as 2,776 acres.

Under this alternative, indirect impacts could include the impacts noted earlier of noxious weed invasion, erosion, and changes in wildlife and livestock distribution. In addition, indirect impacts would likely include increased water being added to riparian systems, which could affect riparian vegetation. Reservoirs that are used in this alternative for holding treated water could produce problems when they are abandoned. Riparian vegetation that developed during the operation dies after abandonment and the bed of the drying reservoir tends to become infested with noxious weeds (Lahti 2001).

Erosion potential may increase under this alternative because there are no reclamation requirements for roadbeds. This is offset somewhat by the stipulation that no slopes greater than 30 percent can be used for CBM construction.

Discharge of water from exploration and production onto the surface could affect the hydrology of as much as 2,776 acres of current riparian vegetation. Changes in hydrology could have both advantageous and undesirable effects on Ute ladies'-tresses through erosion and changed surface and ground water levels.

Other species of concern could be impacted as described for Alternative B and by discharge of CBM water.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusions

There is no requirement for road abandonment so long-term impacts caused by removal of vegetation for roadways is not known, but would occur. Stipulations concerning slope of land for potential CBM sites are likely to protect such slopes from failure and mass wasting problems. A secondary effect is that such areas will remain in their existing habitat and plant communities. Reclaimed areas may revegetate adequately, but this will not restore the sites to previous native vegetation or habitats. There is potential for habitat loss because of the lack of requirements for roadbed reclamation or for abandoned reservoirs. Areas that are not reclaimed would represent a permanent loss of native vegetation and be subject to noxious weed infestations.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through user-created roads, or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Cumulative Impacts

Cumulative impacts from Alternative D would be the same type of impacts as described for Alternative A. The quantity of disturbed habitat would be the same as discussed under Alternative C.

Alternative E—Preferred Alternative

Impacts

The same types of impacts to vegetation and species of concern described for Alternative C would occur under Alternative E because no additional specific mitigation measures will be required and because transportation corridors will not be required. There will be additional impacts in addition to those for Alternative C for the 3,700 wells that will have water basin impoundment structures. This will increase area of total impacts to approximately 73,860 acres. Of this, approximately 66,457 acres of native vegetation will be impacted, 29,168 acres of grassland, 17,972 acres of shrubland, 15,885 acres of forest land, and 3,432 acres of barren land. This Alternative would require a Water Management Plan for every well exploration APD on a site-specific basis for management of production water. There would be no discharge of produced water, either treated or untreated, into the watershed under this alternative unless the operator can demonstrate in the Water Management Plan how discharge could occur without damaging the watershed in accordance with water quality laws. Water quality laws will not protect riparian vegetation from inundation and other changes in the water level as a result of production.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Specific mitigation measures proposed by the Northern Cheyenne Tribe that will be implemented by the BLM are described in the Northern Cheyenne Tribe Mitigation Appendix.

Conclusions

Residual impacts would be the same as described for Alternative C. All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered after well abandonment and by increased access through increased road densities, which may cause greater disturbance and noxious weed infestations.

Cumulative Impacts

The cumulative impacts from Alternative E would be the same types of impacts as described for Alternative A. The quantity of disturbed habitat would be the same as discussed under Alternative C.

Visual Resource Management

Visual Resource Management
Visual resources include Montana features such as landform, water, vegetation, color, adjacent scenery, uniqueness, structures and man-made features of aesthetic value

Alternative A
No Action (Existing CBM Management)

- Federal and State:
    - Dust emissions would reduce visibility to a small degree near active field operations
    - Well pads, roads, and compressors would disrupt the visual landscape. Semi-permanent structures are designed to blend into the surrounding environment
    - Drill rigs, two-track trails, heavy road-making equipment, and generators would disrupt the visual landscape short-term

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- There would be impacts to BLM VRM Class III and IV areas only.
- Type of impacts common to Alternative A would occur under Alternative B, at a scale commensurate with development.
- View shed impacts from road network could last for 20 years until reclamation occurs.

Alternative C
Emphasize CBM Development

- Impacts common to Alternative B would occur with Alternative C, in addition to the following:
    - Above ground powerlines would greatly impact skyline and viewshed.
    - Visual impacts from roads and utility lines is greatest with this alternative.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Impacts common to Alternative B would occur with Alternative D, in addition to the following:
    - Production related roads that are not reclaimed and made part of the permanent road network would result in permanent visual impact.

Alternative E
Preferred CBM Development Alternative

- Impacts would be reduced by the mitigation measures in the Project Plan for visual resources.

Assumptions

Based on the Visual Resource Management (VRM) class, BLM stipulations and conditions of approval would require special design, including location, painting, and camouflage, to blend with the natural surroundings and meet visual quality objectives for the area. A standard component typically includes painting facilities to camouflage them, and a standard color may be specified.

Impacts From Management Common to All Alternatives

Visual resources would be impacted to varying degrees by oil and gas exploration and production activities. Exploration would involve minor visual impacts from clearing operations for access to exploratory sites. The majority of this impact would be expected to result from access road construction, site construction, drill rig operations, and on-site generator use. Short-term visual impacts would occur where construction and drilling equipment is visually evident to observers. Long-term impacts would occur from construction of roads and pads, installation of facilities and equipment, vegetation removal, and change in vegetation communities. These would produce changes in landscape line, form, color, and texture.

Impacts would occur locally on a case-by-case basis as the native vegetation is disturbed and small structures are erected. Landscape line, form, color, and texture would all be expected to change. The view to travelers throughout much of the Powder River area is a high plain with low-lying scrub-shrub vegetation and periodic rock outcrops. In the Castle Rock Project, there is rough terrain, high hills and buttes, and timber present. Much of the area is very scenic and quite a contrast to the landscape of open prairie that might be found in other areas of the Powder River Basin. Visual impacts may include building roads in rough terrain or cutting timber. Introducing man-made structures into this landscape, although small and painted for camouflage, changes the overall nature of the visual resource.

Four thousand acres of surface mining expansion under permit consideration may be approved this year. This mining activity may affect some visual resources in those areas for the next 20 to 30 years.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

CBM production well activities would have visual impacts. CBM wells, typically covered in a box, or “housing” for protection from weather, are isolated structures approximately 4 feet high by 4 feet wide by 4 feet long. The wells are scattered across a wide area, and are connected to field compressors. The compressors are larger, and create more of a visual impact-although in a much smaller area because these structures are more widely distributed. Compressors range in size from field compressors at 8x12x8 (width, length, height; in feet) to sales compressors at 12x18x10. Visual impacts also would arise from construction activities related to developing access to the sites. Exploration well activities may have short-term visual impacts if the exploration wells are not converted to production wells. These short-term impacts (approximately 2 months) would be from the visual effects of the drill rig, portable generator, and access road.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. If there were no CBM development on Tribal Lands, then there is expected to be minimal, if any, impacts on visual resources for the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Exploration wells would cause short term impacts and impacted areas will be repaired on an as needed basis. Minimal permanent visual impacts (approximately 500 acres) are anticipated within the CX Ranch due to well houses, compressor stations, power lines and associated roads

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Visual impacts would occur from the development of CBM wells in this alternative for lands in VRM Classes III and IV. VRM Class I and II lands would not be developed and the No Surface Occupancy stipulation applies. The Controlled Surface Use stipulation would be applied to Class III and IV lands. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation. Impacts from utilities would be minimal as power lines are buried and other utilities are concentrated within roadway corridors.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Residual visual impacts would include the impact of the expanded road network when viewed from a distance or from higher elevations. Cumulative impacts would include the visual impact of additional roads when combined with existing roads and new roads being constructed for other uses.

Alternative C—Emphasize CBM Development

For Alternative C, visual impacts would occur from the development of CBM wells for lands in VRM Classes II, III, and IV. VRM Class I lands would not be developed and the No Surface Occupancy stipulation would apply. The Controlled Surface Use stipulation would be applied to Class II, III, and IV lands. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation.

Power lines would be aboveground in this alternative and roads would be allowed to be placed according to operator plans. This would result in power lines where none now exist, as well as a wider expanse of roads.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Residual visual impacts would include the impact of the expanded road network when viewed from a distance or from higher elevations. There also would be a network of power lines visible from many places.

Cumulative impacts would be the same as described for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Visual impacts would be the same as described for Alternative B.

Conclusions

Residual and cumulative impacts are the same as described for Alternative B.

Alternative E—Preferred Alternative

Visual impacts would occur from the development of CBM wells for lands in VRM Classes II, III, and IV. VRM Class I lands would not be developed and the No Surface Occupancy stipulation would apply. The Controlled Surface Use stipulation would be applied to Class II, III, and IV lands providing options for lessening the visual impact through design and landscape features. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation. Visual contrast Ratings would be completed at the APD or POD stage to identify site specific impacts and determine mitigation.

This alternative does allow for installation of pipelines, power lines and roads where there are none now. But, it also requires that the operator minimize or mitigate impacts from these activities in the Project Plan and state how the surface owner was consulted for input on the location of roads, pipeline and utility line routes. It also allows, at the surface owners discretion, the closing and rehabilitation of roads or the option of leaving them open, after well abandonment.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Use of the mitigation plan as part of the Project Plan would lessen many of the visual impacts but would not eliminate them. New roads and powerlines would be a residual visual impact from this alternative.

There would be cumulative visual impacts from the combination of new and existing roads and utilities.

Wilderness Study Areas

Wilderness Study Areas *There are 10 WSAs within the CBM emphasis area*
Alternative A **No Action (Existing CBM Management)**
• BLM WSAs are closed to oil and gas leasing so there would be no direct impact to WSAs. Because there would be no production activities in BLM planning areas under this alternative, there would be no impacts.
Alternative B **CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• No direct impact to WSAs from CBM development.
Alternative C **Emphasize CBM Development**
• No direct impact to WSAs from CBM development.
Alternative D **Encourage CBM Exploration and Development While Maintaining Existing Land Uses**
• No direct impact to WSAs from CBM development.
Alternative E **Preferred CBM Development Alternative**
• No direct impact to WSAs from CBM development.

Assumptions

Wilderness Study Area (WSA) policy prohibits leasing of WSA lands for resource extraction subject to rights associated with valid claims and leases existing at the time of designation.

Impacts From Management Common to All Alternatives

BLM leasing restrictions are designed to protect WSAs from considerable impact. The WSA policy prohibits leasing of these lands for resource extraction. It is expected that WSAs will not be impacted through conventional oil and gas development under current management. Remote areas may be accessed as CBM development proceeds, but this does not mean that WSAs will be impacted. Specific potential impacts to WSAs cannot be quantified until specific development proposals are received.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

State and fee lands would be impacted by CBM production activity. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from CBM activities.

Conclusion

Impacts from this alternative would be similar to management common to all alternatives. Since stipulations for WSAs prevent leasing of these lands for resource extraction, there are expected to be no major impacts to WSAs.

There are no cumulative impacts from CBM development.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Alternative B would allow development while emphasizing the protection of natural and cultural resources. Under this alternative development would result in increased access to remote areas. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative C—Emphasize CBM Development

Alternative C would emphasize CBM exploration and development with minimal restrictions. The impacts from this alternative would be similar to management common to all alternatives.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Alternative D would encourage CBM development while maintaining existing land uses and protecting down stream water consumers. The impacts from this alternative would be similar to management common to all alternatives.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative E—Preferred Alternative

Alternative E, the Preferred Alternative, would allow CBM development subject to existing planning restrictions and balances CBM development and the protection of the natural environment. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Mitigation

The mitigation measures would be the same as those discussed in the management common to all alternatives.

Conclusion

There are no cumulative impacts from CBM development.

Ute ladies-tresses orchid, *Spiranthes diluvialis*

Wildlife

Wildlife

Mammal Species: 10 bats. 8 shrews, 34 small mammals and lagomorphs, 17 predators, 4 big game,

Bird Species: 32 waterfowl, 33 shore & wading birds, 18 diurnal & 11 nocturnal raptors, 8 gallinaceous, 8 wood peckers, 137 songbirds

Reptiles and Amphibian species: 1 salamander, 4 frogs, 4 toads, 3 turtles, 2 lizards, 9 snakes

Species of Concern consist of 16 mammals, 6 reptiles and amphibians, and 22 birds, including: Sage Grouse, Mountain Plover, Bald Eagle, Interior Least Tern, Peregrine Falcon, Gray Wolf, Black-tailed Prairie Dog, Canada Lynx, Black-footed Ferret, Grizzly Bear

Alternative A
No Action (Existing CBM Management)

- Direct impacts include habitat loss, death from vehicle collisions, and effects associated with greater human access into previously untraveled areas.
- Indirect impacts on wildlife include disturbance and displacement, stress, power lines, noxious weed invasion, user-created roads, habitat fragmentation, water quality degradation from road runoff, and increased livestock grazing.
- Indirect impacts on wildlife would occur on 33,840 to 84,000 acres.
- Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, would be low because of the limited number of CBM wells permitted.
- Species of concern that are not federally protected may be impacted by habitat loss, disturbance, and habitat changes.

Alternative B
CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Same as Alternative A but on a much larger scale. Twenty-five times as many wells, roads, and utility corridors as under Alternative A. 6,680 miles of roads (2.9 to 8.8 miles per square mile). 20,697 miles of utility corridors (9 to 27.1 miles per square mile). Indirect impacts to wildlife on 884,000 to 4.7 million acres from:
- Loss of high value habitats such as prairie dog towns, sage grouse leks, and big game winter range.
- Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal.
- Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles could occur, but impact would be less than Alternatives C or D with the restricting of utilities and roadways to the same corridor.
- All species of concern that are not federally protected may be impacted by habitat loss, disturbance, and habitat changes.

Alternative C
Emphasize CBM Development

- Similar impacts as Alternative B. Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres from:
  - Discharge of untreated CBM water into drainages would impact riparian and wetland habitat and associated species because of poor water quality and erosion.
  - Increased livestock grazing within 2 miles of CBM discharges that occur in areas without summer water
  - Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles, are greater under this alternative than any other because of the increased number of CBM well permits.
  - Potential indirect impacts to T&E species from changes in riparian habitat. Bald Eagles and Interior Least Terns may also be affected if SAR changes affect forage fish.

Alternative D
Encourage CBM Exploration and Development While Maintaining Existing Land Uses

- Impacts would be similar to Alternative B:
  - Discharged treated CBM water would erode riparian and wetland habitat
  - Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles would occur at a level less than Alternative C.
  - Potential indirect impacts to T&E species from hydrology changes caused by increased water levels may impact nesting Interior Least Terns. If hydrology changes from surface water runoff, cause riparian vegetation changes, other T&E species may be impacted as well, such as nesting Bald Eagles.
  - Species of concern that are not federally protected may be impacted by habitat loss, disturbance, and habitat changes.

Alternative E
Preferred CBM Development Alternative

- Direct and indirect impacts would occur similar to Alternative B.
- Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres depending on development spacing.
- Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal.
  - This alternative would not directly impact any T&E listed wildlife species. The mitigation measures mandated in the Biological Opinion would be applied to reduce impacts to T&E species.
  - Potential indirect impacts to T&E species, such as human disturbance, increased poaching or collisions with vehicles could occur.
  - Species of concern not federally protected may be impacted by habitat loss, disturbance, and habitat changes. These impacts may be less than under Alternatives B, C, & D through the implementation of the Wildlife Monitoring and Protection Plan.
- More water would be available for wildlife and livestock as a result of CBM production.

Assumptions

CBM exploration, production, and abandonment on BLM-administered minerals is subject to the stipulations summarized in Table 4-55. These stipulations are recommended for, but do not necessarily apply to, CBM-related activities on non-BLM lands. Therefore, the stipulations would avoid some of the potential impacts on BLM lands, but may or may not avoid impacts on non-BLM lands. The success of these stipulations in avoiding impacts would require collection of site-specific information regarding the resources to be protected in relation to exploration, production, and abandonment plans, followed by strict adherence to the terms of the stipulations. For the purposes of this analysis it is assumed that the stipulations offer some protection to wildlife species on BLM-administered lands. It is further assumed that these stipulations which are very species specific, offer some degree of protection to many other species that use the same habitat during the same time period.

The assumption is made that existing stipulations would provide some protection to sage grouse habitat including lek areas, nesting habitat and winter range. It is recognized that these actions would not completely protect this species. Mitigation measures within the Wildlife Monitoring and Protection Plan (WMPP) will provide additional protective measures. Lease stipulations and terms and conditions would provide protection to raptors and the mountain plover. Protective measures contained in the WMPP (if fully implemented) would help reduce, but cannot avoid all, impacts to all species of wildlife including sagebrush-obligate birds.

The DNRC TLMD may apply the following stipulations on a case-by-case basis to school trust lands leased for oil and gas exploration, development, and production. The noxious weed stipulation is placed on all oil and gas leases issued by TLMD. Some of the stipulations indirectly relate to wildlife, while others are more specific. The dates on the timing restriction stipulation vary depending on the wildlife species to which it applies.

- **Notification:** Lessee shall notify and obtain approval from the DNRC's TLMD prior to constructing well pads, roads, power lines, and related facilities that may require surface disturbance on the tract. Lessee shall comply with any mitigation measures stipulated in TLMD's approval.
- **Weeds:** The lessee shall be responsible for controlling any noxious weeds introduced by Lessee's activity and shall prevent or eradicate the spread of those noxious weeds onto land adjoining the lease premises.
- **Sensitive Areas:** This lease includes areas that may be environmentally sensitive. Therefore, if the lessee intends to conduct any activities on the lease premises, the lessee shall submit to TLMD one copy of an Operating Plan or Amendment to an existing Operating Plan, describing in detail the proposed activities. No activities shall occur on the tract until the Operating Plan or Amendments have been approved in writing by the Director of the Department. TLMD shall review the Operating Plan or Amendment and notify the lessee if the Plan or Amendment is approved or disapproved.

  After an opportunity for an informal hearing with the lessee, surface activity may be denied or restricted on all or portions of any tract if the Director determines in writing that the proposed surface activity would be detrimental to trust resources and therefore not in the best interests of the trust.
- Wildlife Restrictions:
  - To protect certain wildlife during periods important to their survival, surface occupancy or other activity shall be restricted from March 15 through July 15 of each year unless otherwise authorized in writing by the TLMD.
  - Potential wildlife conflicts have been identified for this tract. The TLMD would contact either the Montana Department of Fish, Wildlife, and Parks office or the FWS office in the area for advice on alleviating any possible conflicts caused by lessee's proposed activities. Additional mitigation measures may be required.
  - Wildlife species of concern have been identified on or near this tract. A survey in areas of proposed activity may be required prior to disturbance. Identified species would be avoided, unless otherwise authorized by the TLMD. Additional mitigation measures may also be required.
- Miscellaneous Restrictions:
  - Plant species of concern have been identified on or near this tract. A vegetation survey in areas of proposed activity would be required prior to disturbance. Identified rare plant species would be avoided, unless otherwise authorized by the TLMD.

TABLE 4-55
EXISTING WILDLIFE-RELATED LEASE STIPULATIONS COVERING CBM EXPLORATION AND DEVELOPMENT ON BLM LANDS

Resource	No Surface Use	No Surface Occupancy	No Surface Use or Occupancy
Riparian areas		X	
100-year floodplains of major rivers, streams, and water bodies		X	
Water bodies and streams		X	
Crucial big game and sage grouse winter range*	December 1 - March 31		
Elk calving areas*	April 1 - June 15		
Powder River Breaks bighorn sheep range		Within designated bighorn sheep range	
Grouse leks			Within ¼ mile of lek
Grouse nesting zones*	Within 2 miles of leks from March 1 - June 15		
Raptor nests*	Within ½ mile from March 1 to August 1, within ½ mile of raptor nest sites which have been active within the past 2 years.		Within ¼ mile of nest
Bald eagle nests and nesting habitat	Within ½ mile from March to August 1, within ½ mile of raptor nest sites which have been active within the past 2 years.		Within ½ mile of nests active in the last 7 years and within riparian area nesting habitat
Peregrine falcon			Within 1 mile of nests
Ferruginous hawk			Within ½ mile of nests active within 2 years
Piping plover			Within ¼ mile of wetlands identified as piping plover habitat
Interior least tern			Within ¼ mile of wetlands identified as Interior Least Tern habitat
Prairie dog colonies > 80 acres	Controlled surface use		

Note: These stipulations are attached to leases and can affect exploration and construction

*Stipulation does not apply to operation and maintenance of production facilities.

Please refer to Table MIN-5, Minerals Appendix, for a listing of resource mitigation.

  - A critical weed problem exists on this tract. Additional mitigation measures would be required to prevent further spread of noxious weeds. The department may require such measures as power washing of vehicles, car pooling, timing restrictions for seismic, etc. to facilitate this prevention.
  - This tract contains biological weed-control sites, which must be avoided unless otherwise authorized by TLMD.
- Other:
  - Any activity within 1/8 mile of the river or lake/reservoir on or adjacent to this tract must be approved in writing by the TLMD prior to commencement. No surface occupancy would be allowed within the bed of the river, abandoned channels, the bed of the lake/reservoir, or on islands and accretions associated with the river or lake/reservoir.
  - No activity shall be allowed within 100 feet of any perennial or seasonal stream, pond, lake, prairie pothole, wetland, spring, reservoir, well, aqueduct, irrigation ditch, canal, or related facilities without prior approval of the TLMD.
  - Wooded areas on this tract would be avoided unless otherwise authorized by the TLMD.

In addition to these stipulations, motorized vehicle use for recreationists on state trust lands is restricted by current policy to federal, state, and dedicated county roads or other roads regularly maintained by the county, or to other roads that have been designated open by DNRC. Off road use is prohibited. Increased posting efforts, i.e., Walk-In Only signs, may be implemented by the TLMD to reduce unauthorized use of two-track trails and roads by recreationists to alleviate increased pressure on wildlife. Exploration for and development of CBM wells would cause a wide range of both direct and indirect impacts on wildlife. The extent and duration of effects on wildlife would depend on the animal species, the type and quantity of vegetation removed, the nature and period of disturbance, and the success of stipulations in reducing or avoiding some impacts. The impacts described below assume that the site-specific natural resource information and the stipulations discussed above are successfully used to avoid certain impacts on BLM and state lands.

As previously described, the No Action Alternative includes exploration for and development of a relatively small number of CBM wells (compared to the other alternatives) and the associated roads, pads, power lines, pipelines, utility corridors, facilities, and human activities and presence. Many of the direct and indirect impacts of CBM development on wildlife described for Alternative A would occur regardless of the number of CBM wells developed, with the extent of impacts roughly proportional to the number of wells. These direct and indirect impacts are discussed below under the No Action Alternative and referenced as appropriate in the discussion of the impacts of Alternatives B, C, D, and E. Additional ecosystem-level impacts associated with the substantially larger number of CBM wells that would be developed under Alternatives B, C, D, and E are discussed under those alternatives.

Impacts From Management Common to All Alternatives

The responses of wildlife to facilities and activities associated with oil and gas development are complex but well documented (Wisdom et al. 2000; USDI and USDA 2001; Trombulak and Frissell 2000). Tolerance of various types of environmental disturbances varies among species and among individuals of the same species. The potential for impact is related to the timing and nature of the disturbance, severity of winter, location in the state, habitats and species present, physiological status of the animal, hunting pressure and other disturbance factors, and predictability of the disturbance. The scale of oil and gas development, number and length of associated roads and other facilities, and implementation of measures to avoid or reduce impacts also influence the probability and severity of impacts on wildlife.

Direct and indirect impacts of road construction and use on wildlife and wildlife habitat have been well documented for oil and gas projects and other natural resource developments. Impacts include a wide range of biological effects, such as habitat loss, displacement because of noise and human disturbance, and stress. The types of impacts expected to result from oil and gas development would be similar to those described in detail under Alternative A for CBM development. The extent of the impacts would vary depending on the level of development.

A detailed discussion of impacts and mitigation measures for wildlife is included in the remainder of this section and in the Wildlife Appendix. This discussion addresses the direct and indirect quantitative and qualitative impacts that would likely result from CBM development in the Powder River and Billings RMP areas. The impacts from conventional oil and gas development would be similar to those anticipated for CBM but at a scale associated with conventional oil and gas development as identified in the Miles City District's *Oil and Gas Final EIS*, (BLM 1992).

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

CBM exploration and production includes development of roads, pads, power lines, pipelines, utility corridors, and facilities as well as human activities and regular human presence. Much of this activity would occur in the relatively undisturbed native short grass prairie of eastern Montana, resulting in both direct and indirect impacts on wildlife. Those impacts would be localized around CBM exploration and production sites and proportional to the level of activity at a particular location. The following discussion documents the types of impacts that would be expected from CBM-related actions. These impacts would occur on BLM, state, and private lands.

While the types of impacts described below would occur under all of the alternatives, the extent of the impact would be roughly proportional to the extent of CBM development under each alternative. The number of CBM exploratory and development wells under the No Action Alternative is 1/20th the number that would be developed under the other alternatives. Therefore, the extent to which these impacts would occur under the No Action Alternative is relatively minor compared to the other alternatives.

With a few exceptions, the same types of impacts to wildlife would occur under all of the alternatives. Therefore, they are described under Alternative A below. Differences in the type or extent of impacts between alternatives are noted for Alternatives B, C, D, and E.

Direct habitat loss and direct and indirect impacts because of habitat disruption and wildlife disturbance caused by roads, pipelines, and utility corridors would cause the bulk of the impacts on wildlife. Numerous studies have documented the direct and indirect impacts on wildlife from road development, human presence in formerly remote areas, and facilities construction (Trombulak and Frissell 2000, Wisdom et al. 2000). The nature of these impacts and how they relate to exploration, development, and maintenance of CBM wells is discussed in the text that follows. In most instances, the impacts would occur during all CBM phases. Exceptions are noted as appropriate.

Direct impacts would include loss of habitat to accommodate project features. They would persist for the duration of CBM activities and, in the case of loss of habitat value, beyond that time. Some degree of habitat loss and degradation would continue following CBM abandonment because of ecological differences between reclaimed sites and native vegetation.

The amount and types of habitat that would be directly lost from exploration and development are described in the Vegetation section. The species that would be affected by direct habitat loss would depend on the location of CBM exploration and development and the types of habitat affected. Based on the average area expected to be disturbed by exploration and development of each CBM well, about 675 acres would be impacted during exploration, a total of 1,500 acres would be impacted in the short term by well development (including the 675 exploration acres), and 500 acres would be subject to long term impacts during operations under Alternative A. Direct impacts on wildlife would also include mortality as relatively less mobile small mammals, reptiles, and amphibians are killed during road and other site construction. Smaller mammals, reptiles, and amphibians are most likely to be directly killed by vehicles and are vulnerable when crossing roadways (USDI and USDA 2001). Amphibians are especially vulnerable to being killed on all types of roads because their life histories often involve migration between wetland and upland habitats and individuals are often inconspicuous and slow-moving. Inexperienced juveniles of many raptor species experience high rates of mortality from collisions with vehicles (Trombulak and Frissell 2000). Grouse are particularly susceptible to collision mortality during the spring because they often fly to and from leks near the ground. Also, higher CBM-related traffic volumes on existing paved roads would result in higher mortality rates for reptiles that seek out roads for thermal cooling and heating (Vestjens 1973). Direct mortality from vehicle collisions would be expected to increase for all wildlife along both new and existing roads used for CBM exploration and well construction and maintenance (Groot et al. 1996). Collision mortality would be most injurious to small and declining populations with limited distribution. Direct impacts from collision and crushing would continue for the duration of the project along roads until they are successfully closed and reclaimed. Some additional mortality would continue indefinitely because some new CBM roads would not be closed and reclaimed.

Additional direct impacts would occur on private lands because state and federal lease stipulations are recommended but not required. State requirements would lessen direct impacts on state lands compared to private lands. These impacts include greater potential loss of riparian vegetation and other floodplain habitats valuable for wildlife, abandonment of raptor nests because of direct habitat loss and disturbance, and habitat loss for a wide range of species that occupy prairie dog towns. Note that the percentage of private-lands overlying known coal reserves within the emphasis area accounts for approximately 39 percent.

Table 4-56 indicates the relative level of vulnerability of different representative types of wildlife to direct and indirect impacts. Most indirect impacts on wildlife would occur during all CBM phases on BLM, state, and private lands. The duration of effects would correspond with the duration of each phase and the intensity of activity during that phase. The relative magnitude of impacts would be directly related to the nature and extent of activities associated with each phase of CBM development. Some indirect effects would persist beyond abandonment because continued human use of some CBM and user-created roads that are not closed and reclaimed (USDI and USDA 2001).

Indirect impacts of road development and use as would occur during exploration, development, and production on wildlife and wildlife habitat have been well documented for a variety of natural resource extraction and development projects (Trombulak and Frissell 2000, USDI and USDA 2000, Wisdom et al. 2000). Indirect impacts of CBM exploration and development on certain species of wildlife that are more sensitive to development and human disturbance would occur over much larger areas than the direct impacts.

The *Oil and Gas Development on the Southern UTE EIS* (BLM 2002c) suggested that human presence associated with exploration and development of oil and gas wells disturbed wildlife at distances up to 1/2 mile, and that operation and maintenance activities caused disturbance within 1/4 mile of wells and roads. The disturbance results both from the presence of people and from the noise associated with exploration and development. There are numerous studies documenting wildlife avoidance of roads and facilities and wildlife disturbance at distances of 1,650 feet (Madsen 1985), 6,600 feet (Van der Zande et al. 1980), and as far as 2 miles or more for sage grouse (summarized in Connelly et al. 2000) and raptors (Fyfe and Olendorff 1976).

Elk avoidance of roads has been documented in many studies throughout the West (Lyon 1979 and 1983, Perry and Overly 1976, Rost and Bailey 1979, Ward et al. 1973). Human presence along roads displaces big game species such as elk as well as other species sensitive to human presence from otherwise useable habitat, especially during the day. Elk in Montana prefer spring feeding sites away from visible roads (Grover and Thompson 1986) and both elk and mule deer in Colorado prefer areas greater than 660 feet from roads during the winter (Rost and Bailey 1979). Lyon (1983) studied the effects of roads on elk distribution and habitat use. He reported that within blocks of available elk habitat, road densities of only 2 miles of primitive (undeveloped) road open to vehicle traffic per square mile resulted in elk displacement from over 50 percent of the available habitat in the areas with roads present. The avoidance was due to human disturbance and the resulting lack of security for the elk. This type of disturbance would be greatest in open country such as much of the EIS planning area where line-of-sight distances are relatively long and escape cover is often limited.

Displacement from habitat because of roads, CBM facilities, and human disturbance may result in any of a number of individual and population level impacts on wildlife (Trombulak and Frissell 2000, Wisdom et al. 2000). These include stress, disruption of normal foraging and reproductive habits, abandonment of unique habitat features, and increased energy expenditure. These factors contribute to reduced over winter survival for individuals, poor condition entering the breeding season, reduced reproductive success and recruitment, and eventually population declines (Trombulak and Frissell 2000, Wisdom et al. 2000). For sensitive species, displacement from important habitat features is effectively equal to loss of habitat and the individuals that occupied that habitat. Wildlife cannot generally just move to unoccupied habitat in response to disturbance and survive there because other suitable habitat is already occupied by other individuals of the same species or by similar species using the available resources.

CBM-developed roads and two-track trails would provide public access into previously roadless areas and would result in additional user-created roads and trails branching off from CBM roads (USDI and USDA 2001). Access to most CBM roads on private lands would be restricted by the surface owner. Public access would be restricted on most CBM roads on BLM lands through the use of fences and gates. This is expected to be successful in limiting the majority of public access. However, the open rolling nature of the terrain in the project area combined with the proliferation of four-wheel-drive trucks and all-terrain vehicles would allow the creation of user-created roads (USDI and USDA 2001). This would cause additional road-related direct and indirect impacts over large open areas because of the great sight distances in central and southeastern Montana.

TABLE 4-56
VULNERABILITY OF WILDLIFE TO TYPES OF CBM IMPACTS, ALTERNATIVE A

(The relatively low impact probabilities in this table reflect the fact that the no action alternative includes a small number of CBM wells compared to the other alternatives)

Species/Groups Affected [1]

Type of Impact	Big Game/Large Predators [2]		Sage and Sharp-tailed Grouse [2]		Raptors [2]		Waterfowl/ Shorebirds		Song Birds		Prairie Dog Colonies		Small Mammals		Reptiles and Amphibians		Bats		Small Predators	
	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops
Direct Impacts																				
Habitat loss	1	2	1	2	1	2	0	0	1	2	2	3	1	2	1	1	2	2	1	2
Vehicle collision / crushing	1	2	2	3	1	1	0	0	1	1	1	2	3	3	3	3	0	0	0	1
Greater public access (increased poaching, fire, and legal hunting)	1	3	1	2	1	2	1	1	0	0	1	2	0	1	0	1	0	1	2	3
Indirect Impacts																				
Disturbance and displacement from CBM-associated human presence and activities.	3	3	3	3	3	3	2	2	2	2	1	1	2	2	1	1	0	1	1	2
Noise disturbance/displacement/stress	2	2	3	3	1	1	1	1	3	3	0	0	1	1	1	1	1	1	1	2
Above-ground power lines	0	0	0	3	0	3	0	2	0	2	1	2	0	1	0	0	0	0	0	0
Noxious weed habitat degradation	0	2	0	2	0	2	0	0	0	2	0	1	1	2	0	1	0	0	0	1
Presence of new CBM and user-created roads	0	3	0	3	0	2	0	1	0	2	0	2	0	2	0	2	0	0	1	2
Habitat fragmentation	0	1	0	2	0	1	0	0	0	1	0	1	0	1	0	1	0	0	1	2
Sediment runoff from roads and excess CBM water/water quality degradation	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	2	0	0
Altered surface hydrology (springs and small stream flows reduced)	0	1	0	2	0	0	0	1	0	1	0	0	0	1	0	2	0	1	0	1
Increased livestock use of range due to CBM water sources	0	2	0	3	0	2	0	2	0	3	0	0	0	2	0	2	0	0	0	1

Notes:

Vulnerability of wildlife to categories of impacts are based on the nature of impact, species involved, and relative number of wells.

0 = little or no vulnerability
1 = low vulnerability
2 = moderate vulnerability
3 = high vulnerability

[1] Relative vulnerability assumes collection of site-specific data needed to follow stipulations during exploration and development on BLM lands, and strict adherence to stipulations.

[2] Vulnerability would be slightly lower for certain habitat components on BLM lands during exploration, than on non-BLM lands.

For example, many raptor species that nest along prominent landscape features such as cliffs in open country are easily disturbed during the nesting season, often resulting in nest abandonment (Fyfe and Olendorf 1976). Some CBM roads would continue to be used by the public, including hunters, throughout the entire production phase because road closures are difficult to implement and enforce in flat to rolling short grass prairie habitat. This continued use would hamper reclamation efforts on some CBM roads while others would remain open to the public by choice. Some portion of CBM roads, as well as user-created roads, would become permanent, with all of the associated direct and indirect impacts on wildlife and habitat.

Human use of all types of roads is a source of stress for many species. Roads also may affect an animal's reproductive success (Gutzwiller 1991). Golden eagles prefer to nest away from human disturbances, including roads, and have reduced nesting success in nests located closer to roads than in nests farther from roads (Fernandez 1993). Chronic physiological stress on wildlife can result in increased sickness, a decrease in individual productivity (Knight and Cole 1991, Anderson and Keith 1980, Yarmoloy et al. 1988), and eventually result in population declines (Anderson and Keith 1980).

The increased access provided by both CBM and user-created trails and roads over the span of all CBM phases and beyond would result in additional legal harvest and illegal poaching of game animals (Cole et al. 1997), target shooting of animals such as prairie dogs and other similar species (Ingles 1965), and chasing and harassing of animals (Posewitz 1994, USDI and USDA 2001). Human-caused fires are likely to increase in areas that were not regularly accessed by the general public before CBM and user-created roads were present.

Overhead power lines constructed for production wells pose problems for a variety of wildlife species. Raptors and other species of birds occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines can benefit some raptors in open country by providing hunting perches. However, the additional perches also result in local population declines in prey species. For example, overhead power lines constructed in the vicinity of sharp-tailed grouse leks and wintering areas can substantially increase predation rates on the grouse. The risk of electrocution on federal and state lands is very small because the BLM and State would require that all power lines and poles be constructed to standards that would avoid raptor electrocution. Raptor and sage grouse collisions with power lines have also been noted throughout the west including eastern Montana.

Another wildlife disturbance factor associated with CBM exploration, development, and operation is noise. The highest noise levels and greatest impacts would be expected during exploration and development, with lower noise levels during production operations. Noise levels would be similar on BLM and other lands. Animals would react to noises, but it is especially troublesome for songbirds. Male neotropical migrant birds that breed in short grass prairie, sagebrush, and riparian communities use songs to establish and defend breeding territories and attract females. Noise interferes with this ability, with the level of interference related to the volume and frequency of the noise (Luckenbach 1975, Luckenbach 1978, Memphis State University 1971, Weinstein 1978). Other noise-related problems for birds around CBM exploration and production wells and compressors include interference with the ability to recognize warning calls and calls by juveniles, both of which can result in higher predation rates. The area of disturbance would vary by species and CBM activity. Producing wells would be relatively quiet once regular production is underway. Compressors would be louder with noise levels limited to 50 decibels at a distance of 1/4 mile.

Stipulations prohibit surface occupancy in riparian areas and on floodplains of major rivers. However, they do not prohibit crossing of streams or construction of roads through riparian areas. Roads constructed through riparian areas and other forest and shrub stands for CBM development and operation create edge effects and alter the physical environment (Trombulak and Frissell 2000). Roads create drier conditions in the vicinity of the road, thereby altering habitat for many species. In grassland and shrubland habitats, trails and roads create edge habitat for predators and reduce patch size of remaining habitat for area-sensitive species (USDI and USDA 2001, Ingelfinger 2001). Swihart and Slade (1984) found that prairie voles (*Microtus ochrogaster*), which occur in the EIS planning area, were reluctant to cross tire tracks running through an open field. Reluctance to cross narrow gravel roads has also been observed in white-footed mice (*Peromyscus leucopus*), which also occur in the EIS planning area, and many other rodent species (Mader 1984, Merriam et al. 1989, Oxley et al. 1974). Consequently, roads can function as barriers to population dispersal and movement for small mammals that occur in the EIS planning area.

Many amphibian's annual life cycles require migration between habitats with different ecological properties. These species' populations depend on dispersal connections and landscape links (Gibbs 1998). Simple linear structures such as roads of all types can act as physical and psychological barriers for amphibian movement (Mader 1984, Gibbs 1998). Furthermore, motorized off-highway travel may disrupt reptile and amphibian habitat to the point where it becomes unusable (Busack and Bury 1974). Pronghorns and mountain lions have also demonstrated reluctance to crossing roads (Bruns 1977, Van Dyke et al. 1986).

Noxious weeds and exotic plants rapidly colonize disturbed sites, prevent native species from being re-established following ground disturbance, spread into undisturbed areas reducing habitat value on additional lands, and provide very poor quality wildlife habitat or forage. Mitigation measures discussed under vegetation are intended to avoid, reduce, and control new infestations of noxious weeds through a variety of actions. Consistent and successful application of these mitigation measures would reduce potential habitat degradation. However, use of chemicals to control noxious weeds usually also kills non-target beneficial native plants, contributing to habitat loss.

Roads are sources of fine sediment that can enter wetlands and intermittent and perennial drainages, especially following thunderstorms. Effects include increased turbidity (Reid and Dunne 1984), smothering wetland vegetation, and degradation of habitat for amphibians and other aquatic life (Newcombe and Jensen 1996).

There are no apparent differences between indirect impacts on wildlife on BLM and state lands. Impacts on private lands would be much more substantial because stipulations and mitigation measures would not apply.

Species of Concern

Species of concern include federally listed T&E and candidate species; Montana species of concern; BLM species of concern, USFS species of concern, and MNHP species of concern. For the State of Montana species of concern, this document addresses only those listed as category S1, which are species of extreme rarity or species for which some factor of its biology makes it especially vulnerable to extinction. Chapter 3 of the EIS describes and lists all special-status species.

As discussed in the *Species of Concern* section of Chapter 3 in this EIS, there are 9 federally listed threatened, endangered, and proposed species; and 3 federal candidate species. In accordance with the ESA, listed wildlife must be protected from possible impact by oil and gas and CBM development on all lands. ESA protected plants are not protected on private lands. Additionally, there are many species classified as "species of special concern" by the Montana BLM and MNHP. By policy, BLM management cannot impact these species in a way that may cause further declines in the species' population status. These include 68 plant, 16 mammal, 6 herptile, and 22 bird species, and are listed by the state, BLM, and USFS. This section will address federally listed wildlife species protected under the ESA. General recommendations for other species of concern wildlife species can be found within the general Wildlife impact sections. Federally listed species are discussed individually because of the need for species-specific mitigation measures to avoid extensive impacts. Conclusions are summarized after all of the species are discussed.

Federally Listed Species

Bald Eagle

Bald eagles are sensitive to human presence. Disturbance to foraging, resting, roosting, or migrating eagles is possible through surface use in other areas not addressed by stipulations. Based on the assumptions listed in the introduction to the *Wildlife* section, protection of nests and nesting habitat should prevent eagles from abandoning traditional nesting sites in the project area, but periodic or complete abandonment of non-nesting habitat may occur depending on the level of human use and noise. Above-ground transmission facilities could result in the death of some bald eagles because of electrocution. However, the risk of electrocution on federal and state lands is very small because the BLM and State would require that all power lines and poles be constructed to standards that would avoid raptor electrocution (Table MIN-5). Power lines also pose strike hazards for bald eagles, especially near perennial rivers and water bodies that support fish and waterfowl. Removal of large trees in wintering areas, particularly at established roost sites, would also displace bald eagles by removing perch and roost sites.

Mountain Plover

Mountain plover are most susceptible to disturbance during the nesting season, which occurs between mid-April and early July. Construction activity and operations and maintenance could disturb the nesting/courting birds during this period. Noise and the presence of humans and equipment would be the main causes of disturbance. The absence of stipulations to protect mountain plover nesting areas (prairie dog towns smaller than 80 acres) would result in impacts on this species if exploration or development occurs in or near occupied nesting habitat. Prairie dog towns often are located on flat, topographically low areas.

Interior Least Tern

As with mountain plover, this species is susceptible to disturbance during the nesting period.

Gray Wolf

Roads and the presence of humans would increase the threat from shooting, either on purpose or accidental (when mistaken for a coyote). The potential density of roads in occupied wolf areas could force wolves from occupied areas and could increase stress on wolves and result in the loss of some individuals.

Canada Lynx

Canada lynx would be expected mainly in western and south-central Montana, where high-elevation, dense, old-growth forests are most likely to be found. Although possible, exploration and development of CBM are not expected to occur in these habitats. Therefore, there would be no impacts to Canada lynx.

Black-Footed Ferret

Black-footed ferrets are exclusively found associated with their main prey species: prairie dogs. Prairie dogs are found throughout the project area. Any activity affecting prairie dog colonies has the potential to impact the ferret. Prairie dog colonies are frequently located on level to slightly sloping ground. Two BLM leasing stipulations address black-footed ferret concerns. The first states that exploration in prairie dog colonies within potential black-footed ferret reintroduction areas comply with the Draft Guidelines for Oil and Gas Activities in Prairie Dog Ecosystems Managed for Black-footed Ferret Recovery (FWS 1988, BLM 1992). If these guidelines are accepted, they specify that conditions of approval depend on the type and duration of the proposed activity, proximity to occupied ferret habitat, and other site-specific conditions. Exceptions or waivers of this stipulation may be granted if the Montana Black-Footed Ferret Coordination Committee determines that the proposed activity would have no disagreeable impacts on ferret reintroduction or recovery. The status of the Fort Belknap population allows them to be treated as a proposed species, which may require a conference with FWS if impacts are expected in the vicinity of the reservation.

The second stipulation requires that all prairie dog colonies or complexes greater than 80 acres in size be surveyed for black-footed ferret absence or presence prior to ground disturbance. Prairie dog complexes may consist of several smaller colonies located near one another. The results of the survey determines if restrictions or denial of use are appropriate for the site. Permits issued by MBOGC do not have the same stated requirements for protection of prairie dog towns of certain sizes; however, the ESA's protection of listed wildlife does apply to state and private land. Operators are prohibited from causing harm to the ferret. As appropriate, state leases would include a survey stipulation or contact MFWP stipulation for species of concern.

Implementation of stipulations in potential and occupied habitat would avoid impacts to the ferret on BLM land.

Grizzly Bear

Threats to grizzly bears mainly result from human-bear interactions, which occasionally end in the death of the grizzly bear. If exploration moves into sparsely settled areas or previously roadless areas within grizzly bear range, the possibility of bear-human interaction increases.

Federal Candidate Species

One candidate species may potentially be found in the project area: the black-tailed prairie dog. Although not subject to the substantive or procedural provisions of the ESA, FWS encourages no action be taken that could impact candidate species and contribute to the need to list the species. The state also has a policy that the state should take no action that could contribute to these species being listed.

Black-Tailed Prairie Dog

As discussed under black-footed ferret above, BLM has stipulations governing activities that could impact black-tailed prairie dog towns larger than 80 acres if ferrets are found to be present. However, these protections do not apply if the ferret is not present. The MFWP through a working group composed of state, federal, and private individuals is developing a Prairie Dog Conservation Plan to address how to avoid continuing impacts, which are resulting in population declines. There are no special protective measures being implemented by the state or BLM at this time, although an evaluation including associated impacts to other listed species, in order to identify measures to avoid impacts is required. Construction of CBM exploration and production wells on all land ownerships is expected to impact black-tailed prairie dog towns.

BLM, USFS, and Montana Species of Concern

Under all alternatives, the variety of life forms and the large number of species of concern, the lack of specificity of project locations, and the wide variation in habitat used by these species preclude the ability to identify specific impacts to each individual species of concern. Exploration and development of CBM wells would result in a variety of direct and indirect impacts to species of concern. Specific impacts would depend on the species, the amount and type of habitat removed, and the nature and period of disturbance. Leasing stipulations as discussed above and in the *Wildlife* section would offset or offer some protection to federally listed species. However, there are no stipulations for most species of concern.

Alternative A presents a discussion of impacts to all wildlife species, of which species of concern are a subset. That discussion is not repeated here and the reader should refer to the *Wildlife* section for an understanding of impacts to wildlife species of concern. Some of these species are particularly vulnerable because of their scarcity or narrow habitat niche.

Guidelines recently developed by Connelly et al. (2000) to manage sage grouse populations and their habitat indicate that the stipulations stated above that are intended to avoid impacts on sage grouse leks, and nesting areas during exploration are not adequate to do so. Sage grouse are extremely sensitive to human disturbance and habitat alteration and breeding populations have declined dramatically throughout much of their range (Connelly and Braun 1997) including south-central and southeastern Montana (Eustace 2001). MFWP has been monitoring certain sage grouse leks in south-central Montana since the early 1980s. There has been an approximate 50 percent reduction in the number of these active leks since the monitoring began. Eustace attributes this decline to habitat loss and human disturbance and stated that he believes similar declines have occurred in other portions of Montana. Connelly et al. (2000) indicate that energy-related facilities should be located at least 2 miles from sage grouse leks. They further note that sage grouse populations display four types of migratory patterns: 1) distinct winter, breeding, and summer areas; 2) distinct summer areas and integrated winter and breeding areas; 3) distinct winter areas and integrated breeding and summer areas; and 4) non-migratory populations. Furthermore, recent studies in eastern Idaho have found that sage grouse wintering areas may vary considerably from year to year depending on snow accumulation (Kemner and Lowe 2002).

Avoiding impacts on sage grouse requires protecting the integrity of all seasonal ranges. Average distances between leks and nests vary from 0.7 to 3.9 miles (Autenreith 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000), and movements between seasonal ranges may exceed 45 miles (Dalke et al. 1963, Connelly et al. 1988). Furthermore, sage grouse have high fidelity to all seasonal ranges (Keister and Willis 1986, Fischer et al. 1993). Females return to the same area to nest each year (Fischer et al. 1993) and may nest within 660 feet of their previous year's nest (Gates 1983). However, other studies by Lyon 2000, Fischer et al. 1993, and Berry and Eng 1985 found average distances of 683 meters (2,240 feet), 740 meters (2,427 feet), and 552 meters (1,811 feet), respectively. Therefore, while important, protecting a 1/4-mile (1,320 feet) radius area around leks as specified in the stipulations, may be inadequate to avoid impacts on displaying and nesting birds. Furthermore, this stipulation does not provide sufficient protection of the breeding area or any wintering areas. This stipulation is not adequate to avoid all the impacts on sage grouse from CBM activities. Sage grouse would be impacted by CBM activities that occur within 2 miles of sage grouse leks or within winter range.

Overhead power lines constructed for production wells pose several problems for sage grouse. Sage grouse occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines provide hunting perches for raptors. Predation rates on sage grouse increase dramatically when these lines are located in the vicinity of sage grouse leks and wintering areas, resulting in population declines (Connelly et al. 2000, Milodrgovich 2001).

As discussed in the *Hydrological Resources* section, surface water bodies would not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the unlikely event that there is a very localized connection between a spring-fed stream and groundwater withdrawals, effects on wildlife and habitat would include drying of springs, and reduced flow and duration in intermittent and small perennial drainages. Sage grouse could be severely impacted, as broods spend much of July and August in more mesic sites as sagebrush habitats desiccate (Gill 1965, Savage 1969, Connelly and Markham 1983, Fischer et al. 1998). Reduced availability of mesic sites would reduce sage grouse brood survival and unfavorably affect populations (Connelly et al. 2000).

Crow Reservation

Off reservation CBM development would not indirectly impact wildlife on the Crow Reservation.

Northern Cheyenne Reservation

There would not be any indirect impacts to wildlife on the reservation associated with off-reservation CBM development at the CX ranch.

Mitigation

Agency-applied mitigation measures for BLM and state lands related to natural resources are presented in Chapter 2, and Table MIN-5 of the Minerals Appendix. Agency-applied measures would be implemented as needed and enforced during all CBM phases. Agency-applied mitigation measures are intended to compensate after-the-fact for some impacts that are not avoided through standard lease stipulations. Residual impacts are those that remain after implementation of mitigation measures.

BLM would include and enforce agency applied mitigation (described in Chapter 2 and the Minerals Appendix) through application of standard lease stipulations as needed during the site-specific plan approval stage. Measures to further avoid or reduce impacts in addition to those included at the plan approval stage may be recommended. The state would apply additional mitigation measures on a case-by-case basis through the use of field rules.

Species of Concern Mitigation Measures

Bald Eagle

Before construction begins, a wildlife biologist would survey the construction zone within a 0.5-mile width for bald eagles and bald eagle nests and identify any locations that are found. The use of no surface occupancy or no use stipulations within 0.5 miles of known nests or riparian nesting habitat would reduce but not eliminate potential impacts to nesting, foraging, and roosting bald eagles.

Mountain Plover

Surveys would be made of all prairie dog towns within the roadway corridor and pad sites prior to exploration. If prairie dog colonies or several of the other indicators are found, FWS survey protocol for mountain plover would be followed. See the Wildlife Appendix Biological Assessment for Mountain Plover Survey Guidelines. This includes surveying from May 1 through June 15 for presence or absence on potential sites. Exploration and Construction would be avoided in these areas during this time period to assure that potential nesting mountain plovers are not prevented from setting up territories as a result of the presence of equipment and humans.

Interior Least Tern

Potential habitat near exploratory drilling and construction sites would be identified and appropriate surveys would be conducted for this species. Surface occupancy and use is prohibited within 1/4 mile of wetlands used by nesting interior least terns during exploration. This stipulation would minimize impacts to interior least tern. Occupied wetlands and water levels would be protected in all phases of drilling and construction and no discharge into occupied wetlands would be permitted. Operations are not affected by this stipulation.

Gray Wolf

Prior to construction in potential gray wolf habitat, surveys would include specific searches for this animal, occupied dens, or scat. The corridor would be surveyed in the spring, prior to construction, by a wildlife biologist for scat. If scat is found, the site would be surrounded by a buffer zone recommended through consultation with an FWS biologist. If wolves or other wolf indicators are found, FWS would be consulted and proper protocols followed.

Canada Lynx

Any construction areas or drilling pads located in high elevation, old growth forested areas, especially areas with populations of hares or rabbits, would be surveyed prior to construction for scat and individuals following established protocols. If found, the site would be avoided and surrounded by a buffer zone recommended by FWS biologists.

Black-Footed Ferret

Implementation of stipulations in potential and occupied habitat would avoid impacts to the ferret on BLM land.

Grizzly Bear

Garbage and other human refuse would be removed from drilling and construction sites on a daily basis in potential bear habitat to avoid attracting bears. Surveys for scat and other sign of grizzly bears in remote, sparsely roaded areas would be conducted prior to construction. If found, protocol would be established after consultation with FWS biologists.

Black-Tailed Prairie Dog

Development of mitigation measures for the prairie dog depends upon the recommendations being developed in the previously mentioned Prairie Dog Conservation Plan. This plan would address how to avoid continuing impacts.

Conclusions

Agency-applied mitigation measures would reduce erosion potential and facilitate reclamation of disturbed lands during abandonment. If a state or private CBM project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the Federal agency.

Stipulations would avoid some impacts for certain species. However, they would not be 100 percent effective because of limits on available biological information, some stipulations do not apply to operations, and non-CBM human activities that would be facilitated by new CBM roads. The potential for impacts is relatively low under Alternative A compared to the other alternatives because of the limited number of CBM wells. Natural resource mitigation measures (Table MIN-5, Minerals Appendix) generally focus on vegetation reclamation and related efforts to reduce erosion and water pollution. Measures intended to reduce surface disturbance in sensitive habitats are to be implemented "to the extent practicable." Therefore, it is likely that some sensitive habitats and species could be directly impacted by CBM development under Alternative A. The intent of reclamation is to re-establish a vegetative cover on disturbed areas rather than to restore native plant communities as they existed prior to disturbance. Plant species diversity would be lower on reclaimed sites than before disturbance, reducing overall wildlife habitat values. Existing mitigation measures would not effectively compensate for indirect impacts on wildlife.

Some wildlife species of concern and their preferred habitat may be disturbed or lost during construction. Individual animals may be lost through collisions with vehicles and indirect impacts as described previously for general wildlife. Indirect impacts to species of concern also could result in displacement or abandonment of habitat or to increased poaching pressure. Species of concern on all lands do not have the same level of protection as ESA-protected species. Therefore, some direct and indirect impacts on individuals or even populations within metapopulations would be expected. This alternative would have the least impact on all species of concern because of the limited number of wells and minor (500 long-term acres) associated disturbances.

If habitat degradation is kept at a minimum, mitigation measures are followed for all listed species of wildlife, and appropriate surveys are conducted prior to construction to ensure that these species are not found within or near well sites and other project facilities and corridors and, if found, are buffered by suitable no construction zones and work restrictions recommended by FWS biologists, federally listed wildlife species would be affected but are not likely to be critically affected, directly, by this alternative. For the life of the permit and afterward if road reclamation is not required, these species would be detrimentally affected because of increased road density and associated human activity.

There could be some displacement of bald eagles in non-nesting habitat. Black-tailed prairie dogs would be impacted by this alternative in all dog towns where CBM development occurs within or adjacent to the town. This includes towns less than 80 acres and larger towns if no black-footed ferrets are present.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal, changes in vegetation species composition after reclamation, increased access because of more roads, increased noise levels, and conflicts with CBM infrastructure and increased human pressure. Changes in stream or spring hydrology and increased SAR and salinity values in water and soil could also have adverse impacts.

Cumulative Impacts

The cumulative impacts on wildlife resulting from the effects of Alternative A include the direct loss of wildlife habitat, habitat fragmentation, and wildlife mortality from collisions. Noise and human presence would disturb sensitive wildlife species over large areas near developed well fields, causing local population declines for some species. This would be particularly problematic for sensitive species such as raptors, sage grouse, and other birds dependent on sagebrush habitats.

Impacts from Wyoming CBM development on wildlife and wildlife habitat would be similar to those described under Alternative A, but at a far larger scale. More than 2.5 times as many CBM wells may be developed in the Powder River basin of Wyoming than the 18,300 considered under Alternatives B, C, D and E. The magnitude of direct and indirect Wyoming CBM impacts on wildlife and wildlife habitat would be about 2.5 times greater than described for Alternatives B, C, and D (described in the following sections). CBM development in Wyoming would have cumulative effects for many species of concern in

Montana, especially under two categories: groundwater and surface water. There would be an increased flow and slight alteration in SAR values in the Powder, Little Powder, and Tongue rivers in Montana (See *Hydrology* section for specific changes). The SAR in the Tongue river is currently 0.86 to 1.36, based on the minimum monthly mean flows. Under Alternative A, it would be 1.93 to 2.52. This is not expected to be enough to cause any major changes in vegetation because most plants are not affected until the SAR exceeds 3 and some cases not until it exceeds 12.

The increase in water volume at certain times has the potential to cover sand bars and other open areas. There would be potential cumulative impacts for bald eagles and interior least tern that are present in these rivers as well because flow fluctuations and alterations in SAR values could affect the food chain these species rely on and because it may affect their nesting habitat.

Cumulative impacts of other activities, including conventional oil and gas, active coal mines, and fires are expected to result in the long term loss of an additional 37,000 acres. Indirect impacts on wildlife would be similar to those described above and would affect an area much larger than 37,000 acres. Some impacts on sensitive and protected species would be expected from development on this scale.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Generally, the same types of impacts on wildlife described for Alternative A would occur under Alternative B. However, Alternative B includes development or the drilling of 18,300 CBM wells. This is about 20 times as many wells; miles of roads, pipelines, and utility corridors, and facilities and 20 times more human activity than for Alternative A. It is important to recognize that the development would take place over a 20-year period and that the initiation of well development (20 times) would not occur all at once. However, production at any given well is expected to continue for 20 years so there would be substantial overlap between wells developed early and those developed later in the 40-year time frame between development of the first wells and closure of the last ones. Because of this level of CBM development, Alternative B would have widespread ecosystem-level types of impacts on wildlife and wildlife habitat as discussed at length for Alternative A.

Virtually every wildlife species that occurs within CBM development areas would be impacted to some degree, with sensitive species suffering the greatest impacts because of their already precarious status. For example, wintering and nesting sage grouse and nesting golden eagles would be expected to suffer large-scale impacts. It is likely that, at this scale of development, some species would become locally rare or vacate large areas. All of the wildlife groups listed in Table 4-56 would have a very high probability of being impacted throughout the CBM development area under Alternative B because of the scale of the development.

Table 4-54 in the Vegetation section notes the number of acres of direct impact (habitat loss) and the number of miles of roads, pipelines and utility corridors that would result from CBM development under Alternatives B, C, D, and E. Development under Alternative B would result in the direct short term loss of about 55,400 acres of wildlife habitat to well pads, roads (6,680 miles), and pipeline and utility corridors (20,679 miles). Long term impacts would persist on about 33,000 acres after reclamation of exploration disturbance. However, as noted for Alternative A, plant species diversity would be lower on reclaimed lands than before disturbance, resulting in reduced habitat value for many species and habitat fragmentation for some species. Additional vegetation would be disturbed by multiple exploration vehicles moving across the landscape searching for suitable locations to drill exploratory wells. Direct and indirect impacts on wildlife from this scale of development would be widespread.

The discussion of impacts for Alternative A indicated that elk, sage grouse, raptors, and other species are particularly sensitive to human disturbance associated with CBM development and related roads. Not all wildlife species are as sensitive to roads and disturbance as these species. However, those that are the most sensitive often include species that are declining in numbers and distribution because of this sensitivity, such as sage grouse and many raptors, including ferruginous hawks (*Buteo regalis*). Table 4-57 provides estimates of the area of habitat within which species sensitive to disturbance and roads may be affected both within and around the perimeter of CBM well fields. Potentially affected areas are estimated for both 1/2-mile and 2-mile perimeters around well fields and related activity (Fyfe and Olendorff 1976, Lyon 1983, Connelly et al. 2000).

TABLE 4-57

AREA OF DIRECT IMPACTS AND INDIRECT WILDLIFE DISTURBANCE AND DISPLACEMENT[1] WITHIN AND AROUND CBM WELL FIELDS FOR MORE SENSITIVE WILDLIFE SPECIES FOR ALTERNATIVES B, C, D, AND E

(ASSUMES 200 WELLS PER WELL FIELD, 8, 16, OR 24 WELLS PER SQUARE MILE[2])

		Indirectly Affected Area Within 1/2 Mile		**Indirectly Affected Area Within 2 Miles**	
		Additional Area Affected Around Perimeter of Each Well Field	**Total Affected Area Within Well Fields and Within 1/2 Mile of Well Field Perimeters[3]**	**Additional Area Affected Around Perimeter of Each Well Field**	**Total Affected Area Within Well Fields and Within 2 Miles of Well Field Perimeters[3]**
Number of Wells Per Square Mile	**Acres Per Well Field**	**Acres**	**Acres**	**Acres**	**Acres**
Alternatives B, C, D, and E—18,300 Wells and 91.5 Well Fields					
8	16,000	7,040	2,108,160	35,840	4,743,360
16	8,000	5,120	1,200,480	28,160	3,308,640
24	5,312	4,352	884,256	25,152	2,787,456
Cumulative Impact of CBM Development Only for Alternatives B, C, D, and E—26,500 Wells and 132.5 Well Fields					
8	16,000	7,040	3,052,800	35,840	6,868,800
16	8,000	5,120	1,738,400	28,160	4,791,200
24	5,312	4,352	1,280,480	25,152	4,036,480

[1] See text for discussion of individual and population level consequences of displacement.

[2] A larger average number of wells per field would reduce the affected area. For example, fields averaging 1,000 wells per field and 8 wells per square mile would impact 1,738,061 acres instead of 2,108,160 acres.

[3] Affected area around well fields assumes there is no overlap between affected areas of adjacent well fields. Overlap would reduce affected perimeter area.

Table 4-57 assumes that well field development would include 8, 16, or 24 wells per square mile and that each well field would include 200 wells. CBM well development is projected to occur over a 20-year period with an average well life of 20 years. Therefore, the information presented in Table 4-57 represents the maximum area of disturbance for sensitive wildlife species in year 20 when all wells would be developed and none would have been closed. Approximately 44 percent of the wells and associated disturbance would be in place in year 5, 72 percent in year 10, and 87 percent in year 15. By year 20, indirect impacts of CBM development would affect sensitive species of wildlife on between 880,000 and 4.7 million acres. Sagebrush obligate song birds, which are suffering range-wide population declines, are also sensitive to disturbance and habitat fragmentation. They avoid pipeline and road corridors even when the roads are unpaved and receive little use (Ingelfinger 2001). His research in Wyoming natural gas fields found that the density of sagebrush obligates including Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*), and sage thrasher (*Oreoscoptes montanus*) were reduced by 50 percent within 100 meters of lightly traveled unpaved roads compared to densities in undisturbed sagebrush communities. Sage sparrow density along a natural gas pipeline route with no traffic was 64 percent lower within 100 meters of the route compared to densities in nearby undisturbed sagebrush. Ingelfinger (2001) attributed these declines to noise (along the roads), habitat fragmentation, edge avoidance, and possibly inter-specific competition with horned larks, a species that forages along roads. At full development there would be 6,680 miles of new roads. Assuming no overlap, 100 meters on each side of these roads would include over 530,000 acres and additional effective habitat loss would occur along pipelines. These lands are included in the information presented in Table 4-57.

Some additional direct and indirect impacts not already described for Alternative A would be expected to occur under Alternative B because of the much greater scale of CBM development. Prairie dog colonies tend to be located on relatively flat ground, and often in valleys. Prairie dog towns also support much higher densities of birds and mammals and greater avian species richness than adjacent prairie (Agnew et al. 1986). Various studies have reported 163 vertebrate species using black-tailed prairie dog colonies in Montana including several species of concern such as burrowing owl and mountain plover (Reading et al. 1989, Tyler 1968, Clark et al 1982, Agnew 1986). Prairie dog colonies larger than 80 acres are protected from surface occupancy only if black-footed ferrets are found and this protection applies on BLM lands only. Smaller colonies and larger colonies without ferrets would effectively receive no special protection on any lands. Considering the ferrets extreme rarity, it is unlikely that any prairie dog towns would be protected from impacts from CBM development. Road, well pad, pipeline, and utility line placement across and on prairie dog towns would result in direct mortality and impact large numbers of species through habitat loss and displacement to unsuitable habitat, which would result in the loss of displaced individuals.

As discussed in the Hydrological Resources section, surface water bodies would not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the very unlikely event that there is a very localized connection between a spring-fed stream and groundwater withdrawals, effects on wildlife and habitat would include reducing or even drying of springs, and reduced flow and duration in intermittent and small perennial drainages. Reduced surface water would result in more xeric vegetation and would impact all types of wildlife, but would be especially important for amphibians and certain bird species that depend on mesic plant communities. Sage grouse could suffer substantial impacts because broods spend much of July and August in more mesic sites as sagebrush habitats desiccate (Gill 1965, Savage 1969, Connelly and Markham 1983, Fischer et al. 1998). Reduced availability of mesic sites would reduce sage grouse brood survival and unfavorably affect populations (Connelly et al. 2000).

There would be no differences between the direct and indirect impacts on BLM and state lands. Impacts on private lands could be much more substantial because stipulations and mitigation measures would not apply.

Federally Listed Species

Direct impacts to federally protected species are prohibited by law and would be the same as under Alternative A.

The potential for indirect impact would be greater under this alternative because of the much larger amount of habitat that would be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads, and utility lines. Increased roadways for more wells would result in greater human access, with the potential for more poaching, indirect disturbance, or harassing of protected species. As many as 4.7 million acres of habitat for species sensitive to human disturbance may be indirectly affected by CBM development (Table 4-57). Since federally listed species are often rare because of their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

The same agency-applied mitigation measures described for Alternative A would apply to Alternative B. The effect of these mitigation measures on impacts would also be the same as under Alternative A.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative B and be the result of developments in close proximity to reservation boundaries.

Regulations related to wildlife would be under the jurisdiction of Tribal Laws and not state or federal laws. Exceptions to these impacts would include disruption of migratory pathways of some wildlife, impacts resulting from vehicular traffic, hunting of wildlife, and noise and other impacts to wildlife near borders of the reservation. Full-scale development forecast under this alternative would increase the risk of these kinds of impact to wildlife on the reservation.

Wildlife vulnerability to impacts would be similar to that presented in Table 4-56. Indirect impacts of this level of CBM development on the Crow Reservations on species sensitive to human disturbance are shown in Table 4-57 under cumulative impacts.

Northern Cheyenne Reservation

There would be no direct impacts to wildlife on the Northern Cheyenne Reservation from off-reservation development. Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B and be the result of developments near reservation boundaries.

Conclusions

The same types of impacts described for wildlife and species of concern under Alternative A would be expected. However, the extent of impacts would be about 20 times greater in area and scope because of greater CBM well development and associated direct and indirect impacts. Stipulations would avoid some impacts for certain species. However, they would not be 100 percent effective because of limits on available biological information, some stipulations do not apply to operations, and non-CBM human activities that would be facilitated by new CBM roads. The potential for impacts is high under Alternative B because of the large number of CBM wells.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative A except that the impacts from Montana CBM development would be substantially greater. Additional CBM development on the Crow and Northern Cheyenne Reservations and in the Custer National Forest is expected to result in the direct short-term loss of an additional 25,000 acres and long term loss of about 14,750 acres. Degraded habitat value of reclaimed lands would be similar to that described for Alternative A. Other actions considered to be cumulative impacts would result in the long term loss of an additional 37,000 acres.

Table 4-55 estimates additional cumulative indirect impacts of more CBM development on species sensitive to human activities and development. It is estimated cumulative indirect impacts of CBM development in Montana could affect sensitive wildlife on between 1.28 and 6.87 million acres. Since sensitive and federally listed species are often rare because of their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

Alternative C—Emphasize CBM Development

The same types of impacts on wildlife described for Alternatives A and B would occur under Alternative C. However, Alternative C would have direct impacts on more acres of wildlife habitat than Alternative B because Alternative C includes fewer measures to reduce impacts. Table 4-54 in the *Vegetation* section notes the number of acres of direct impact (habitat loss) and the number of miles of roads and pipeline and utility corridors that would result from CBM development under Alternative C. Development under Alternative C would result in the direct short term loss of about 70,000 acres of wildlife habitat to well pads, roads (9,018 miles versus 6,680 miles for Alternative B), and pipeline and utility corridors (27,917 miles versus 20,679 miles for Alternative B). More land would be directly impacted because roads would not be required to follow existing corridors and there would be no requirement to place pipelines and utilities in corridors. Long term habitat loss would affect about 47,600 acres and reclaimed areas would have reduced habitat value. Direct and indirect impacts on wildlife from this scale of development would be widespread.

Table 4-57 estimates the area on which sensitive species of wildlife would be disturbed by CBM development under Alternative C. Indirect disturbance and effective habitat loss for sensitive species would be the same as under Alternative B and would indirectly affect sensitive wildlife on between 880,000 and 4.7 million acres. Effects of disturbance were described under Alternative A.

CBM development produces excess surface water that has not been available in the past. It is unlikely that this water would go unused. Information in the *Water Resources Technical Report* (ALL 2001b) indicates that virtually all of the water produced during CBM extraction would be suitable for livestock or wildlife use. Cattle typically move up to 0.6 mile from water to graze in steep terrain, but will move up to 2 miles in relatively flat areas (Stoddart et al. 1975). CBM development areas that are greater than 0.6 to 2 miles from natural or currently developed perennial water sources, depending on terrain, are either not used or used lightly by livestock on a seasonal basis. Increased stock water availability from CBM-produced water would permit private land owners and state and BLM grazing permittees to adjust the distribution and management of their herds to use more of the forage within 0.6 to 2 miles of CBM wells. Each CBM production well field that is located in an area without current perennial water sources could make up to several thousand acres available to more intensive cattle grazing. Utilization would be most intensive in the immediate vicinity of the water discharge location wells. Increased livestock grazing reduces forage otherwise available for wildlife and degrades habitat value for many species of wildlife (Saab et al. 1995). The additional CBM water would also be available for wildlife use.

The release of untreated CBM water to surface drainages and streams could result in serious erosion, damaging or destroying instream and stream bank riparian vegetation that constitutes valuable wildlife habitat (Regele and Stark 2000). The erosion can result in increased sediment loads, which along with the potential high salinity and sodicity, can degrade the stream and impact riparian vegetation. Impacts of discharging sodic CBM waters would likely be greatest in intermittent and smaller perennial drainages during low-flow periods. Releases during low-flow periods of late summer and fall would have the greatest potential to impact riparian habitat and sensitive wildlife species such as amphibians. This is also the time when this vegetation is naturally stressed because of low water and amphibians are confined to remaining water or are burrowed into shallow mud. The potential for impacts on riparian habitat and amphibians exists along drainages and streams throughout the CBM development area.

Because of the typically low flows of the CBM wells (approximately 5 to 10 gallons per minute), it is likely that these impacts would be localized in the vicinity of the discharge, unless flow were collected from a large number of wells, which may occur. There are no apparent differences between the direct and indirect impacts on BLM and state lands. Impacts on private lands would be much more substantial because stipulations and mitigation measures would not apply.

Species of Concern

Direct impacts to federally protected species are prohibited by law and are the same as under Alternatives A and B.

The potential for indirect impacts or modification to habitat would be greater under this alternative than for Alternative B (Table 4-57) because fewer potential impacts would be avoided. Reclamation of disturbed areas would not necessarily restore sites to previous habitat configurations or specific habitat needs of listed species. This alternative would have the greatest acreage of disturbance from roadways, pipelines, and utilities of any alternative. Power line strike hazards are highest with this alternative. This alternative may affect SAR levels in rivers that would affect BLM and state species of concern and bald eagle foraging, interior least tern foraging success, and nesting habitat. Production water disposal could also develop riparian areas that would be lost after abandonment. If listed species come to rely on these areas of developed habitat, this would lead to future declines when the water source for them no longer exists.

Crow Reservation

Impacts to the Crow Indian Reservation would be similar to the indirect impacts described in general for Alternative C. These indirect impacts would occur in areas adjacent to off-reservation CBM developments.

Northern Cheyenne Reservation

Since there is no Tribally sponsored CBM development impacts to the Northern Cheyenne Reservation would be similar to the indirect impacts described in general for Alternative C. These indirect impacts would occur in areas adjacent to off-reservation CBM developments.

Conclusions

The same types of impacts described for Alternatives A and B for wildlife and the same as described for Alternative B for sensitive species would be expected. However, impacts would be at a greater level due to the emphasis on CBM production under Alternative C. Approximately 21,000 more acres would be directly impacted in both the short and long term compared to Alternative B.

Cumulative Impacts

The types of cumulative impacts would be the same as described for Alternatives A and B. CBM development is expected to result in the direct short and long term loss of an additional 21,000 acres compared to Alternative B. Degraded habitat value of reclaimed lands would be similar to that described for Alternative A. Other actions considered to be cumulative impacts would result in the long term loss of an additional 37,000 acres.

Table 4-57 estimates additional cumulative indirect impacts of more CBM development on species sensitive to human activities and development. It is estimated cumulative indirect impacts of CBM development in Montana could affect sensitive wildlife on between 1.28 and 6.87 million acres. Since sensitive and federally listed species are often rare because of their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The same types of direct and indirect impacts on wildlife described for the Alternatives A and B and in Tables 4-56 and 4-57 would occur under Alternative D. Areas affected by direct and indirect impacts would be similar to those reported for Alternative B with the additions noted below. The impacts of the beneficial use of water for livestock grazing described for Alternative C would also occur under Alternative D. Unlike Alternative C, CBM water discharged under Alternative D would be treated before release. Additional treated water provided to intermittent and small perennial streams may result in both impacts and benefits, depending mostly on the volume of discharge water relative to the natural flow, the steepness of the terrain, and the erosiveness of the soil. Relatively high volumes of water discharged into smaller drainages could erode the channel, destroying riparian vegetation either directly or as a result of channel down-cutting, which would reduce water availability to plants. Intermittent water sources that become perennial because of CBM discharge would attract grazing livestock for longer periods of the year, resulting in degraded range conditions and reduced forage and cover for wildlife. Increased flows may also result in improved and more extensive riparian vegetation in intermittent drainages where seasonal water stress limits the current extent or condition of the vegetation and in more widespread water availability for wildlife. However, this benefit would be offset if more livestock grazing occurs in the vicinity and downstream of the discharge points. Lack of a requirement to reclaim roads and abandoned reservoirs would increase the potential for noxious weed occurrence and resulting habitat degradation.

There are no apparent differences between the types of direct impacts on BLM or state lands. Furthermore indirect impacts would have very little difference between BLM and state managed lands. Impacts on private lands would be much more substantial because stipulations and mitigation measures would not apply.

The same agency-applied mitigation measures described for Alternative B would apply to Alternative D. The effect of these mitigation measures on impacts would also be the same as under Alternative B.

Species of Concern

Direct impacts to federally protected species are prohibited by law and are the same as under Alternative A. The potential for indirect impacts or modification to habitat would be greater under this alternative than Alternatives A or B, but less than Alternative C. As with those alternatives, reclamation of disturbed areas would not necessarily restore sites to previous habitat configurations or specific habitat needs of listed species. There would be increased roadways with this alternative over either Alternatives A or B. As with Alternative C, production water disposal, which would be treated under this alternative, could develop riparian areas that would be lost following abandonment.

Mitigation is the same as for Alternative B.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative B. However, since there would be no Tribal sponsored development, impacts would be limited to adjacent boundaries from off-reservation development. Small areas of private development on the reservation would cause direct impacts similar to those described in Alternative D, but adjusted for the limited scale of development.

Northern Cheyenne Reservation

Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B and are expected to occur in areas adjacent to off-reservation development. No Tribal sponsored CBM development is anticipated for this alternative and therefore no direct impacts to wildlife are expect to occur on the Reservation.

Conclusions

Direct, indirect, and residual impacts on wildlife would be similar to those described for Alternative B.

Under all alternatives, the variety of life forms and the large number of species of concern, the lack of specificity of project locations, and the wide variation in habitat used by these species preclude the ability to identify specific impacts to each individual species of concern. Exploration and development of CBM wells would result in a variety of direct and indirect impacts to species of concern. Specific impacts would depend on the species, the amount and type of habitat removed, and the nature and period of disturbance. Leasing stipulations as discussed above would reduce or avoid some impacts to federally listed and other sensitive species. However, there are no stipulations for most species of concern.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative B.

Alternative E—Preferred Alternative

The types of impacts on wildlife under Alternative E would be similar to those described in Alternative A. However, the magnitude of the impacts would be substantially higher because the level of development would be much higher, as shown on Table 4-57. Examples of types of impacts similar to Alternative A follow:

- Direct habitat loss and direct and indirect impacts because of habitat disruption and wildlife disturbance caused by roads, pipelines, and utility corridors would cause the bulk of the impacts on wildlife.

- Direct impacts would include loss of habitat to accommodate project features. They would persist for the duration of CBM activities and, in the case of loss of habitat value, beyond that time. Some degree of habitat loss and degradation would continue following CBM abandonment because of ecological differences between reclaimed sites and native vegetation.

- Based on the average area expected to be disturbed by exploration and development of each CBM well, Alternative E would result in the direct disturbance of 73,860 acres resulting from development of 18,300 wells, 9,018 miles of roads, and 27,917 miles of utility corridors (Table 4-54). Direct impacts on wildlife would also include mortality as relatively less mobile small mammals, reptiles, and amphibians are killed during road and other site construction. Smaller mammals, reptiles, and amphibians are most likely to be directly killed by vehicles and are vulnerable when crossing roadways (USDI and USDA 2001).

- Additional direct impacts would occur on private lands because state and federal lease stipulations are recommended but not required.

- Table 4-56 indicates the relative level of vulnerability of different representative types of wildlife to direct and indirect impacts. Most indirect impacts on wildlife would occur during all CBM phases on BLM, state, and private lands. The duration of effects would correspond with the duration of each phase and the intensity of activity during that phase. The relative magnitude of impacts would be directly related to the nature and extent of activities associated with each phase of CBM development. Some indirect effects would persist beyond abandonment because continued human use of some CBM and user-created roads that are not closed and reclaimed (USDI and USDA 2001).

- Table 4-57 provides estimates of the area of habitat within which species sensitive to disturbance and roads may be affected both within and around the perimeter of CBM well fields. Potentially affected areas are estimated for both 1/2-mile and 2-mile perimeters around well fields and related activity (Fyfe and Olendorff 1976, Lyon 1983, Connelly et al. 2000). The information presented in Table 4-57 represents the maximum area of disturbance for sensitive wildlife species in year 20 when all wells would be developed and none would have been closed. By year 20, indirect impacts of CBM development would affect sensitive species of wildlife on between 880,000 and 4.7 million acres. Species sensitive to indirect impacts at this scale were discussed under Alternative A.

- Overhead power lines constructed for production wells pose problems for a variety of wildlife species. Raptors and other species of birds occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines can benefit some raptors in open country by providing hunting perches.

However, the additional perches also result in local population declines in prey species. For example, overhead power lines constructed in the vicinity of sage grouse and sharp-tailed grouse leks and wintering areas can substantially increase predation rates on the grouse. The risk of raptor electrocution on federal and state lands is very small because the BLM and State would require that all power lines and poles be constructed to standards that would avoid raptor electrocution. Raptor and sage grouse collisions with power lines have also been noted throughout the west including eastern Montana.

- Stipulations prohibit surface occupancy in riparian areas and on floodplains of major rivers. However, they do not prohibit crossing of streams or construction of roads through riparian areas. Roads constructed through riparian areas and other forest and shrub stands for CBM development and operation create edge effects and alter the physical environment (Trombulak and Frissell 2000). Roads create drier conditions in the vicinity of the road, thereby altering habitat for many species. In grassland and shrubland habitats, trails and roads create edge habitat for predators and reduce patch size of remaining habitat for area-sensitive species (USDI and USDA 2001, Ingelfinger 2001). Swihart and Slade (1984) found that prairie voles (*Microtus ochrogaster*), which occur in the EIS planning area, were reluctant to cross tire tracks running through an open field. Reluctance to cross narrow gravel roads has also been observed in white-footed mice (*Peromyscus leucopus*), which also occur in the EIS planning area, and many other rodent species (Mader 1984, Merriam et al. 1989, Oxley et al. 1974). Consequently, roads can function as barriers to population dispersal and movement for small mammals that occur in the EIS planning area.

- The assumption is made that existing stipulations would provide some protection to sage grouse habitat including lek areas, nesting habitat and winter range. It is recognized that these actions would not completely protect this species. Mitigation measures within the Wildlife Monitoring and Protection Plan (WMPP) will provide additional protective measures. Lease stipulations and terms and conditions would provide protection to raptors and the mountain plover. Protective measures contained in the WMPP (if fully implemented) would help reduce, but cannot avoid all, impacts to all species of wildlife including sagebrush-obligate birds.

See Alternative A for a complete discussion of the types of impacts on wildlife expected from CBM development, including impacts on threatened and endangered and candidate species.

The magnitude of impacts would be somewhat less severe than expected under Alternatives B, C, or D because of implementation of the Wildlife Monitoring Protection Plan (WMPP), which is located in the Wildlife Appendix. Project Plans would be developed and approved using the programmatic guidance outlined in the WMPP. They would include baseline inventory for sensitive wildlife and habitats in areas where such inventories have not been completed. Certain broad landscape level inventories would be conducted by the BLM. The BLM or Operators would conduct additional, more detailed inventories and monitoring. Operators would be required to submit plans that demonstrate how their project design minimizes or mitigates impacts to surface resources and meets objectives for wildlife before exploration and approval of the APD. The WMPP would be a cooperative approach that incorporates adaptive management principles to try to deal with impacts as they occur. The Plan also establishes a framework that encourages industry, landowners, and agencies to work together constructively to incorporate conservation measures into CBM development. All CBM development would follow the programmatic guidance to address wildlife concerns, and each individual Project Plan would include a site-specific Monitoring and Protection Plan which includes mitigation specific to species or local habitats. Over the life of the CBM project, monitoring and evaluation through area specific WMPPs would offer some insight as to the effectiveness and failures of management actions, and therefore encourage adaptive strategies to address specific and unforeseen problems.

Some examples of how the WMPP would be applied are described below. It must be recognized however, that because of the scale of CBM development proposed under this alternative, it would only be possible to reduce or lessen impacts to important wildlife habitats utilizing measures described in the WMPP.

As discussed in alternative A, the primary objective of reclamation is to restore vegetative cover to the disturbed site. While present required seed mixes include native species, restoration to near-native conditions is not achievable. However, flexibility provided by the WMPP allows for more creative options in reclamation plans to restore important wildlife habitats. An example would be to focus on restoration of sagebrush stands on big game winter ranges as opposed to establishing a herbaceous cover only.

As part of the approval process for project protection plans, location and use of roads would be a very high focus. Project design would include locating roads in such a manner as to avoid crucial areas within big game and sage grouse winter ranges (i.e. south facing slopes, sagebrush flats and valley floors), raptor nesting areas and prairie dog towns. Additionally, stipulations may be applied that preclude use of these roads during critical time periods of the year (seasonal restrictions) or day (timing restrictions) that would apply to all CBM activities.

The power infrastructure associated with CBM development is identified as a major wildlife impact. Agencies already require all powerlines to be raptor proof according to accepted standards. However, additional stipulations may be required based on site specific needs. Examples of this may be locating powerlines away from sage grouse leks and winter concentration areas, burying powerlines in critical areas and applying more aggressive raptor-proofing options than previously required. .

Mandatory mitigation measures are listed in Chapter 2.

Species of Concern

The types of direct and indirect impacts would be similar to Alternative A. This alternative would have more impact on all species of concern because of the increase in number of wells and their associated disturbances.

In accordance with the ESA, federal agencies must consult with US Fish and Wildlife Service (USFWS) if a federal action may affect a federally listed species. The USFWS has offered a Biological Opinion (BO) located in the Wildlife Appendix addressing impacts to wildlife species protected under the ESA and described in the Biological Assessment (BA) (Wildlife Appendix). The BA determined that the preferred alternative posed the potential for "take" of individual animals or habitat for both the bald eagle and mountain plover. Mandatory terms and conditions were included in the BO to reduce the likelihood of take and exempt BLM from Section 9 of ESA through a incidental take statement.

The magnitude of impacts for these species would be less severe under this alternative than other expanded development alternatives because of the mandatory implementation of Terms and Conditions (T&C) prescribed in the USFWS BO (Wildlife Appendix). Other listed species that occur in the planning area addressed in the BA and BO and were determined as "not likely to be adversely affected" by CBM developments.

The assumption is that these same T&Cs would offer some degree of protection to other species associated with bald eagles and mountain plover habitat. An example of this is as follows:

> Due to the declining status of mountain plover in the analysis area and the plover's attraction to prairie dog towns, all active black-tailed prairie dog colonies within suitable mountain plover habitat would have No Surface Occupancy (NSO) to protect this important and limited plover nesting habitat. This NSO would be applied only to federally managed surface acres.

In addition to prairie dogs, other associated species including burrowing owl, ferruginous hawk and many other species would benefit from this action. T&Cs addressing surface use, roads, powerlines modifications and surface occupancy would ultimately provide benefits to species other than mountain plovers and bald eagles. For example, power line avoidances and installation of anti-perching devices in high avian use areas such as wetlands, prairie dog towns and grouse leks would not only protect bald eagles and other raptors but also the prey species associated with those habitats.

Additionally, there are many species classified as "BLM sensitive species or special concern" by the Montana BLM and MNHP. These include 68 plant, 16 mammal, 6 herptile, and 22 bird species. By policy, BLM management cannot impact these species in a way that may cause further declines in the species' population status and lead to a federal listing. Because changes in a species' status under the ESA are based on range-wide variables, it is very difficult to identify a particular threshold as to when that species' status would change to threatened or endangered. Implementation of conservation measures described in the WMPP and monitoring of populations of special status species would give us the ability to reduce impacts to individuals and detect changes in population status allowing us to make adjustments in management. Therefore it is reasonable to assume the BLM policy 6840 for special status species would be met.

Impacts on species of concern are discussed under Alternative A. The WMPP addresses guidance for developing Plans of Development. Project Plans and conservation measures applied as Conditions of Approval provide a full range of practicable means to avoid or minimize harm to wildlife species or their habitats. Operators would minimize impacts on wildlife by incorporating applicable WMPP programmatic guidance into Project Plans. Not all measures may apply to each site-specific development area and means to reduce harm are not limited to those identified in the WMPP. BLM and MFWP would work together through a Cooperative Agreement to collect baseline information about wildlife and sensitive habitats possibly containing special status species.

The WMPP is intended to reduce potential impacts on a variety of sensitive species by requiring inventories prior to exploration. This action would likely reduce potential direct impacts on sensitive species and may also reduce potential indirect impacts in some cases. However, given the scale of CBM development, it is very unlikely that all direct and indirect impacts on species of concern can be avoided. Monitoring findings may result in additional conditions of approval and mitigation measures for CBM development that occurs after initial monitoring data are collected and analyzed, which could further reduce, but not eliminate, potential impacts on sensitive species.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative E. Impacts would be limited to adjacent boundaries from off-reservation development.

Northern Cheyenne Reservation

Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative A. Specific mitigation measures proposed by the Northern Cheyenne Tribe that would be implemented by the BLM are described in the Northern Cheyenne Mitigation Appendix.

Conclusions

The types of direct, indirect, residual, and cumulative impacts would be generally the same as those noted for Alternatives A and B. Discharge of treated water to intermittent and small perennial streams would result in both impacts and benefits to aquatic/riparian vegetation, amphibians, aquatic wildlife and invertebrates; depending mostly on the volume of discharge water relative to the natural flow.

Direct, indirect, and cumulative habitat loss, wildlife disturbance and mortality, and poaching would be greater with this alternative than either Alternatives A or B because of the greater area of disturbance from the increased level of well development (Table 4-54). The magnitude of direct impacts would be greater than those of Alternatives B, C, and D (Table 4-54). Indirect and cumulative impacts would be similar to those of Alternatives B, C, and D (Table 4-57). Implementation of the WMPP would reduce direct and indirect impacts.

All species of concern that are not federally protected would be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads, or by changing streambed hydrology.

Cumulative impacts would be similar to those described for Alternatives A and B.

Aquatic Resources

Wildlife (Aquatic Resources) ***Fish species vary between watersheds within the CBM emphasis area from 8 in the Little Big Horn River to 32 in the Musselshell River.*** *Special Status Aquatic Species: Montana Arctic grayling, Pallid sturgeon, and Warm spring zaitzevian riffle beetle*
Alternative A **No Action (Existing CBM Management)**
• Minor short-term impacts on aquatic resources during CBM exploration and production may result from increased sediment delivery and its effects on aquatic habitat and organisms, possible impedance of fish movements, potential for accidental spills of petroleum products, and possibly increased fish harvest. • Relatively minor long-term increases in river flow and TDS concentration from production water discharge would not be expected to impact aquatic resources. • Conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges. • Impacts from CBM abandonment would be minor and subside over time.
Alternative B **CBM Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• The same types of impacts described for Alternative A (No Action) would occur under Alternative B, except as noted in the following two bullets. – The scale of potential impacts associated with sediment delivery, fish movements, petroleum spills, and fish harvest would be greater under Alternative B because of the development of over 18,000 CBM wells across a much larger geographic area. – No CBM production water would be discharged to surface drainages under Alternative B. • Based on fish species, fisheries management policies, fisheries resource values, and projected intensity of CBM development, the drainages most sensitive to the effects of CBM development would be the Lower Bighorn, Upper Tongue, and Little Bighorn; then the Lower Tongue, Little Powder, and Rosebud; followed by the Mizpah. • The potential for affecting aquatic resources in sensitive drainages would be less under Alternative B than under Alternatives C or D.

Alternative C Emphasize CBM Development
• The same types of impacts described for Alternative A would occur under Alternative C, but they would occur on a far greater scale because of the development of over 18,000 CBM wells. • A total of 0.67 billion cubic feet of untreated CBM production water would be discharged to drainages each year. Resultant flow and TDS increases could potentially impact aquatic organisms, especially in smaller drainages during dry times of the year. • Conditions of MPDES Permits would provide legally enforceable assurances preventing the degradation of water quality, aquatic resources, and the beneficial uses of receiving waters. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative C than under Alternatives B or D.
Alternative D Encourage CBM Exploration and Development While Maintaining Existing Land Uses
• The same types of impacts described for Alternative A would occur under Alternative D, but they would occur on a far greater scale because of the development of over 18,000 CBM wells. • The annual discharge of 2.24 billion cubic feet of treated CBM production water through pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year. • The treatment of CBM production water prior to its discharge would greatly reduce the potential for elevated TDS and salinity impacts on aquatic resources. • MPDES Permits would provide legal assurances that water quality, aquatic resources, and beneficial uses of receiving waters would be protected. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative D than under Alternative B but less than under Alternative C.
Alternative E Preferred CBM Development Alternative
• Same as Alternative B.

Assumptions

The BLM has identified numerous mitigation measures in Chapter 2 that would be implemented to avoid or minimize impacts on biological resources and hydrological features resulting from CBM exploration, production, and abandonment activities on BLM lands. These measures are common to all of the alternatives being analyzed in this EIS and are derived from current BLM leasing stipulations (contained in Minerals Appendix, Table MIN-5), standard operating procedures and BMPs, and State of Montana field orders. Several of the mitigation measures related to aquatic resources are briefly reviewed here for reader reference prior to discussing potential impacts and impacts that would be avoided or minimized, assuming the successful implementation of these mitigation measures.

A key mitigation measure that directly affects aquatic resources is that the Montana and Wyoming Water Quality Agreement, which is pending final approval, would preserve the current water quality in the Tongue River and prevent Wyoming operators from discharging poor quality production water into the Tongue River. Examples of other mitigation measures related to aquatic resources that are referenced in Chapter 2 and described in Table 4-55 of the Wildlife section include a prohibition on the surface occupancy or use of water bodies and streams, riparian areas, and 100-year floodplains of major rivers, streams, and water bodies. In addition, surface occupancy and use is prohibited within 1/4 mile of designated reservoirs with fisheries to protect the fisheries and recreational values of reservoirs.

Specific mitigation measures are directed at protecting water quality and aquatic resources in drainages by controlling erosion and sediment delivery, particularly on steep slopes and during wet times of the year; minimizing the number of stream crossings; reclaiming, reseeding, and revegetating disturbed areas; and maintaining a Spill Prevention Control and Countermeasures (SPCC) Plan to deal with accidental spills and control storm water run-off. A number of mitigation measures that would be applied on a case-by-case basis, as needed, are described in Appendix Table MIN-5. Examples of mitigation measures associated with aquatic resources, some of which are directed at special status species, include considerations of the location and timing of stream crossings as they relate to fish spawning periods and habitat, and the minimization or avoidance of in-channel activities to reduce the potential for habitat loss. The reader is referred to Chapter 2, Table 4-53, and Minerals Appendix, Table MIN-5 for a complete listing of all mitigation measures.

These mitigation measures would avoid some of the impacts that may otherwise occur on BLM lands in the absence of such measures, but they do not apply to CBM-related activities on non-BLM lands and therefore would not avoid impacts on non-BLM lands. The only management objective that applies to BLM lands and lands subject to state regulations is the required placement of untreated waters from exploration activities in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

CBM exploration, production, and abandonment activities would potentially impact aquatic resources in a number of ways. The likelihood of these impacts occurring depends on the exact nature, location, and timing of CBM activities; the proximity of CBM activities to water bodies and the presence of sensitive species and/or sensitive life stages in these water bodies; and the nature of mitigation measures that would be implemented to minimize, avoid, or mitigate the potential occurrence of impacts. The success of these actions requires and assumes a site-specific understanding of the resources to be protected and adherence to mitigation measures during CBM activities. The assumptions stated in the Hydrological Resources section of this chapter also form a portion of the framework for analyzing potential impacts from CBM activities on aquatic resources.

The discussion of impacts in the following text for the No Action Alternative first describes the types of impacts that would result from CBM activities in the absence of mitigation measures . It then assesses the likelihood of such impacts occurring based on the nature and magnitude of CBM activities, the proximity of those activities to aquatic resources, and the rigor of mitigation measures that would be implemented on lands managed by BLM and on lands subject to state regulations. Conclusions address the residual impacts that would remain following the implementation of mitigation measures. Conclusions also address the cumulative impacts that would result from the residual impacts of CBM development combined with the potential effects of other projects in the area.

Many of the same types of direct and indirect impacts on aquatic resources would occur regardless of the number of CBM wells developed, although the magnitude of impact would vary. Many of the same types of mitigation measures also would be implemented. Therefore, the detailed discussions of types of impacts first presented for the No Action Alternative are referenced, as appropriate, in subsequent discussions of impacts for Alternatives B, C, D, and E. The potentially greater magnitude and geographic extent of impacts on aquatic resources because of the substantially greater number of CBM wells that would be developed under Alternatives B, C, D, and E are discussed under those alternatives.

Impacts from Management Common to All Alternatives

Types of impacts on aquatic resources, including fish, aquatic invertebrates, and their habitat, potentially resulting from CBM development activities would be similar to those described for oil and gas exploration and development activities (MBOGC 1989). These include direct removal of habitat, habitat degradation from sedimentation, altered spawning and seasonal migration because of stream obstructions, direct loss of fish from accidental spills or pipeline ruptures releasing harmful substances, increased legal harvests of fish because of increased human access, and reduced stream flows because of removing water for drilling activities. These potential types of impacts are common to all alternatives and are described further under Alternative A (the No Action Alternative). An additional impact on aquatic resources that would only occur under Alternatives A, C, D, and E is the potential for altered stream water quality and/or increased flows in those instances when production water is discharged to drainages. This impact also is described under the No Action Alternative. However, no impacts would result from conventional oil and gas activities because of protection of reservoirs on 1,844 acres.

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBM Management)

Numerous irrigation-related or naturally occurring dewatering problems that affect aquatic resources have been identified for drainages in the Billings RMP and Powder River RMP areas that would continue under the No Action Alternative. These problems were described in discussions of the affected environment and are not CBM-related. In the Billings RMP area, these include periodic dewatering of portions of the Yellowstone River and downstream sections of the Clarks Fork and Bighorn rivers, and chronic dewatering of the Boulder River, the upstream section of the Clarks Fork, portions of the Musselshell River, and Careless Creek. In the Powder River RMP area, dewatering problems include periodic dewatering of the downstream section of the Tongue River and chronic dewatering of the Powder River. Dewatering indicates a reduction in streamflow, usually during the irrigation season (July through September), beyond the point where stream habitat is adequate for fish. Periodic dewatering indicates a crucial problem in drought or water-short years, and chronic dewatering indicates a critical problem in virtually all years (Montana NRIS 2001).

The two most common forms of water quality effects in the Billings RMP and Powder River RMP area drainages are from elevated sediment and salinity concentrations, primarily from non-point sources related to agricultural practices (MBOGC 1989).

Levels of dissolved solids in drainages tend to increase proceeding downstream because of contributions from irrigation return flows, increased base flows that have been in contact with soil and rocks for long periods of time, and effects of human activities. Water quality in intermittent and ephemeral drainages often is of poor quality because of the sudden and highly variable nature of discharge (snowmelt, intense rainstorms) that would result in elevated turbidity, dissolved solids, and suspended sediment levels in these and in downstream perennial drainages (MBOGC 1989). These water quality conditions would likely continue under the No Action Alternative.

Fish populations and habitat in perennial and intermittent streams in the Billings RMP and Powder River RMP areas are impacted by drought, high temperatures, prolonged cold, heavy icing, and flooding (BLM 1995). Pond habitat and fisheries in the RMP areas also would be affected by dry, low-water years when excessive water temperatures and reduced dissolved oxygen levels during summer would kill fish, and by extended periods of ice and snow and subsequent oxygen depletion during winter that would kill fish (BLM 1995). Water quality and habitat for fish in the Park, Gallatin, and Blaine counties' drainages that were discussed in Chapter 3 generally tend to be good to excellent, primarily because of the proximity to headwaters and/or the often undeveloped or remote nature of the surrounding areas. All of these resource conditions would probably continue under the No Action Alternative.

Previous studies have summarized the ways in which aquatic resources, including fish, aquatic invertebrates, and their habitat, would potentially be impacted, either directly or indirectly, by CBM activities (BLM 1992, USDI 2000, Regele and Stark 2000). Many of these impacts are the same as described for oil and gas exploration and development activities (MBOGC 1989). They include the following effects:

- Loss of aquatic and riparian habitat at stream crossings and near well sites
- Habitat degradation and loss from increased sediment delivery and sedimentation
- Altered spawning and seasonal migrations of fish because of stream obstructions
- Direct loss of fish and aquatic invertebrates from accidental spills, leakage, and runoff of harmful substances into drainages
- Increased legal and possibly illegal harvests of fish because of increased human presence
- Altered water quality and increased stream flows from discharging CBM production water into nearby drainages

Crossing streams and placing facilities such as culverts, bridges, and cattle guards during the construction or upgrading of access roads to well sites would result in the localized loss of aquatic and riparian habitat. Depending on stream location and hydrology, drainages may provide year-round (perennial) or seasonal (intermittent or ephemeral) habitat for a variety of fish species and their life stages, including spawning, incubating, rearing, holding, and over-wintering. Drainages also provide habitat for aquatic macro- and micro-invertebrates that are typically important fish foods, such as aquatic insects, zooplankton, clams, snails, and worms, as well as habitat for aquatic plants, including periphyton, phytoplankton, and vascular macrophytes. Instream activities also would alter habitat characteristics such as water depth, velocity, and habitat types that are important to native and introduced fish species as well as benthic invertebrates.

The loss of riparian habitat would be especially important in smaller drainages because of its many influences on the quality of aquatic habitat. Murphy and Meehan (1991) reported that riparian habitat can form a protective canopy that provides overhead cover for fish and moderates the extreme effects of air temperatures during summer (helps to cool streams) and winter (helps to insulate streams). Riparian habitat also helps reduce soil erosion and filters sediment before it enters streams, stabilizes streambanks, and allows for the formation of undercut banks that provide cover for fish. In addition, riparian habitat contributes litter (nutrients and food for invertebrates) and woody debris (instream cover) to drainages, and it provides habitat for insects that fall to the water's surface and are consumed by fish (Murphy and Meehan 1991). The loss of these riparian functions would result in impacts on aquatic resources.

Soil disturbance, erosion, and runoff during CBM activities would result in increased sediment delivery to streams and the degradation or loss of aquatic habitat. Examples of such activities include the construction, upgrading, use, maintenance, and retirement of access roads; the installation of culverts, bridges, and cattle guards at stream crossings; other instream activities such as fording streams; site preparation, well drilling, and related onsite facilities; and the construction and placement of pipelines for gas delivery. The potential for erosion and runoff would be greatest where wet or moist soils on steep slopes with little or no vegetative cover have been compacted by heavy equipment (BLM 1992).

Increased sediment delivery to drainages would affect aquatic resources through the sedimentation of habitat and increased levels of turbidity and suspended sediment in the water column. Increased sedimentation would cause a reduction or elimination of stream bottom habitat used by aquatic insects such as caddisflies, mayflies, and stoneflies; a subsequent reduction in aquatic insect abundance and diversity; a reduction in the permeability among interstitial spaces within spawning gravels that inhibits the flow of well-oxygenated water and the removal of metabolic wastes; a subsequent reduction in spawning success, hatching success, and fish production; and a reduction in the interchange of surface and subsurface waters in the hyporheic (mixing) zone beneath the stream channel (Nelson et al. 1991, USDI 2000). Substantially increased sedimentation would eliminate or reduce the depths of pools that provide important year-round cover for juvenile, sub-adult, and adult fish, and would cause the premature siltation of beaver ponds, which often provide year-round habitat for trout (MBOGC 1989). If severe enough, increased sediment loads would cause the erosion and migration of stream channels (Chamberlin et al. 1991), and the degradation of aquatic and riparian habitat.

Elevated turbidity and suspended sediment levels caused by increased sediment delivery would have sublethal and acute effects on fish. Nelson et al. (1991) reported that suspended sediment concentrations of 1,200 mg/l can cause mortalities in under yearling salmonids, while suspended sediment concentrations as low as 100 mg/l up to 1,000 mg/l are sometimes associated with a general reduction in fish activity, impaired feeding, reduced growth, downstream displacement, and decreased resistance to other environmental stressors. MBOGC (1989) reported fish and fish food production would be affected by the abrasive effects of very fine sediment on fish embryos and fry and on immature aquatic insects. In addition, very turbid waters would exhibit increased temperatures because of the water's capacity to retain more heat. This would affect those fish and invertebrate species with the most restrictive cold-water or cool-water thermal requirements.

The most severe aquatic impacts resulting from increased sediment delivery would be to trout, whitefish, and grayling. These species have relatively narrow habitat requirements, including the need for clean, cold, well-oxygenated water and/or gravels for spawning, egg incubation, rearing, and adult success (Bjornn and Reiser 1991). The MBOGC (1989) generally concluded that in Montana, increased sediment delivery would have a greater impact on aquatic resources in high-gradient mountain streams than in low-gradient prairie streams. Mountain streams typically support the very sensitive and highly valued species of salmonids, which are generally much less tolerant of increased sediment and turbidity levels than are the warm water fish species found in the lower-gradient prairie streams and rivers in Montana. The MBOGC (1989) also noted that the potential for impacts from sediment delivery to drainages may be greatest in mountainous terrain because roads and pipelines are typically constructed close to streams where slopes are less steep.

Fish spawning migrations and localized movements would be affected in the event of improper placement, misalignment, or construction of culverts and bridges. Improperly designed facilities would block fish passage directly or constrain fish movements by creating hydraulic barriers caused by excessive water velocities or insufficient water depths. Furniss et al. (1991) reported that unless properly designed, stream crossings would be considered dams that are designed to fail, with subsequent impacts on fish passage and the sedimentation of habitat. Four aspects of culvert design, including diameter, length, slope, and vertical drop to the water's surface, can potentially affect fish passage, especially of smaller fish. The MBOGC (1989) reported that perched culverts or small-diameter culverts with high water velocities effectively block trout spawning migrations. Bell (1986) stated that improperly designed culverts may preclude the passage of small fish and possibly discourage larger fish from attempting passage.

Accidental spills, leakage, and runoff or leaching of petroleum products, drilling fluids stored in reserve pits, and other potentially harmful substances such as CBM production water (discussed further below) to surface water drainages may have acute and chronic effects on fish and their foods (BLM 1992; USDI 2000). These effects are influenced by the nature of the substance including its persistence and fate, volume of spill, distance from surface water and likelihood of entry, the volume and diluting ability of the receiving water, and sensitivity of organisms exposed to the substance. Direct effects can include mortalities of aquatic organisms, while indirect effects may be exhibited through chemically induced changes in densities and community structures of aquatic organisms (Norris et al. 1991). Examples include alteration of environmental characteristics such as cover, food, or some other variable important to the well-being of fishes. Effects would be comparatively greater during low-flow than high-flow periods and in smaller rather than larger water bodies. The MBOGC (1989) concluded that the potential for impacts from accidental spills may be greatest in headwater mountain streams with relatively low flows because soils in such areas are often porous and runoff to streams is direct and rapid.

Increased human access because of new roads and increased human activity associated with CBM exploration and production may result in increased legal and illegal harvest of fish from nearby drainages (MBOGC 1989). Besides angling mortalities of game species, legal fishing activities may result in the trampling of eggs and recently emerged fry from wading in streams, and walking on or next to streambanks may cause increased bank erosion and habitat sedimentation.

As discussed in the *Hydrological Resources* section, surface water bodies should not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the unlikely event that there is a very localized connection between a spring-fed stream and groundwater withdrawals, examples of resultant habitat modifications that could impact fish and invertebrates include reduced water depths; slower water velocities; fewer and/or shallower pools and riffles; increased water temperatures during summer; exposed stream channel bottom and stream banks; reduced habitat for spawning, rearing, holding, and refugia; reduced riparian habitat quantity, quality, and function; and reduced fish and invertebrate production.

Several examples illustrate the potential effects, or in the case of the proposed project, the anticipated absence of effects, of groundwater withdrawals on surface water hydrology and aquatic resources. The *Southern Ute DEIS* (USDI 2000) noted the potential for decreased surface water flows because of CBM production water withdrawals from groundwater aquifers on the Southern Ute Indian Reservation in New Mexico and Colorado. That analysis estimated that between 1,600 and 2,500 acre-feet of water may be lost from instream flows, and concluded that this was not anticipated to impact fish habitat. This is equivalent to a 2.2 to 3.5 cfs reduction in instream flows spread evenly over a year. Under other circumstances and depending on the size of the drainage potentially affected, a flow reduction of about 3 cfs would have substantive effects on very small perennial and intermittent drainages, but negligible effects on very large perennial drainages. Studies also were conducted for the Deer Creek Coal Bed Methane Project, which is in the Tongue River watershed in the northwestern part of the Powder River Basin (BLM 2000a). Hydrologic analysis of the Deer Creek Project, like the hydrologic analysis in this EIS, indicated that because of the sealing effect of the overlying aquitards, water levels in shallow aquifer zones and in shallow wells in the project area would not be impacted by water level drawdowns caused by CBM well operations (BLM 2000a). The Deer Creek analysis concluded that flows and aquatic habitat in project area drainages should not be depleted or aquatic habitat degraded. Similar findings were presented for studies of the Castle Rock Project, which concluded that cumulative impacts on the surface water resources of the exploration area, which include the Powder River and Pumpkin Creek, are expected to be minimal to nonexistent in the short term (BLM 2000b).

Aquatic resources would be affected by the discharge to surface waters of groundwaters that are withdrawn during CBM production activities. The discharge of groundwaters would alter surface water quality and increase flows, impacting aquatic habitat and biota. The effects of production water discharge would be most evident in smaller drainages during low-flow times of the year, particularly in those drainages with low levels of TDS. The specific ionic constituents comprising TDS are also important determinants of a water body's effect on aquatic organisms. For purposes of comparison, fresh water usually has a salinity of less than 500 mg/l while sea water has an average salinity of 35,000 mg/l. The surface discharge and runoff of production water also would cause erosion of soils and even higher concentrations of solids. For the proposed Deer Creek Project in the Tongue River watershed, TDS values of water produced from CBM wells are expected to range from 2,500 to 3,500 mg/l (BLM 2000a). Examples of TDS concentrations in groundwater found in coal aquifers of the Powder River Basin were presented previously in the *Hydrological Resources* section of this document, and ranged from 401 to 2,646 mg/l.

Based on the mitigation measures and assumptions described earlier, relatively few impacts on aquatic resources would be expected from exploration activities at 400 CBM wells on BLM-administered lands under Alternative A. However, short-term impacts on aquatic resources resulting from CBM exploration activities on BLM-administered lands would include increased sediment delivery to nearby drainages during runoff events. Fish passage would also be impeded if culverts or bridges are used to cross drainages and are inappropriately placed. In addition, there is the potential for the accidental spill or leakage and entry of petroleum products into drainages associated with vehicles using the access roads and present at exploration sites. Increased access and human presence during exploration activities also may result in some increased harvest of game fish. There would be no anticipated change in streamflow volumes by exploration activities since these activities would not discharge production waters into surface drainages. Any untreated waters from exploration would be placed in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

As noted in the earlier discussion of wildlife resources, nearly all of the mitigation measures for CBM activities on BLM lands do not apply to CBM activities on non-BLM lands (i.e., lands subject to state regulations). Therefore, the absence of mitigation measures that prohibit the occupancy or use of water bodies, floodplains, and riparian areas on lands subject to state regulations increases the likelihood that exploration activities at 275 CBM wells on state-regulated lands within or immediately adjacent to these habitats would have a greater potential for impacting aquatic resources than on BLM-managed lands. These impacts would be in addition to those described in the preceding text for exploration activities on BLM lands. However, the magnitude of these impacts would probably still be minor because of the somewhat limited nature of exploration activities. There would continue to be the potential for increased sediment delivery, possible impedance of fish movements in streams, potential for accidental spills of petroleum products, and possibly increased fish harvest. However, there would be no effect on stream flow volume. In addition, as noted for exploration activities on BLM lands, there would be requirements for placing untreated exploration water in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

The State of Montana has stressed the importance of protecting high-value recreational fish populations that occur in drainages in the CBM-emphasis area. It is expected that the state would not allow exploration activities to be conducted in a manner that would impact these highly valued fisheries. They include trout fisheries and populations of other important species of game fish, particularly in those drainages in each county that have been judged by the State of Montana to support a resource of national renown and to have outstanding, high, or substantial fisheries resource values.

Under the No Action Alternative, CBM production would only occur on the CX Ranch, where there are no specific mitigation measures for CBM production activities. Because of this, potential impacts from the development of 250 producing CBM wells on the CX Ranch would generally include the same impacts that were described for exploration activities on lands subject to state regulations, although they would extend over a longer period of time. Discharge of production water from these wells would be regulated by the Montana DEQ via a MPDES permit, which would allow 1,600 gallons per minute (gpm) discharge into the upper Tongue River from up to 11 discharge points.

The TDS concentration in CBM-produced water from the CX Ranch is about 1,400 mg/l, while Regele and Stark (2000) reported the average TDS concentration for the Tongue River is 284 mg/l. The resultant TDS concentration from discharging 3.6 cfs (approximately 1,600 gpm) of production water (1,400 mg/l TDS) to the Tongue River with a flow of 39 cfs (284 mg/l TDS) would be 378 mg/l TDS. This represents a 94 mg/l increase in TDS over background levels, but it is still well below the TDS guideline of 1,000 mg/l associated with possible effects on fish. Resultant water temperatures would likely be similar to that of the Tongue River upstream of the mixing zone because of the predominance of river flow. This would not be the case when there is very low or sometimes no background flow in the Tongue River, as is the case during critical drought periods. Under the very worst-case conditions, the only flow in the river would theoretically consist of CBM produced water with a TDS concentration of approximately 1,400 mg/l that has been discharged to the river. While this TDS value would exceed the 1,000 mg/l TDS concentration associated with possible effects on aquatic organisms, it would be the only source of water in the drainage and probably provide at least some refuge for aquatic organisms until background flows return. Water temperatures may initially be somewhat cooler than would normally occur during low-flow periods, but they would likely increase proceeding downstream in response to local climatic conditions.

This same type of analysis can be done by evaluating the effect of produced water and the dilution effect of Tongue River water using bioassays and predictive modeling. However, the results of bioassays differ substantially from and show far fewer effects on aquatic organisms than suggested by predictive modeling. The Mount et al. (1997) model would predict that the produced water from the CX Ranch wells would be lethal to 100 percent of fathead minnows. Once the water is discharged to the Tongue River, the dilution would be such that there would be no increase in toxicity to fish in the river. The model would indicate that if there was no or very little dilution of this discharge by either flowing or standing river water, it would be toxic to fish and aquatic invertebrates.

Results of actual whole effluent toxicity (WET) testing using fathead minnows and a cladoceran (water flea), *Ceriodaphnia dubia*, showed far fewer or no mortalities than predictive modeling. A representative sample of effluent from Fidelity Exploration &

Production Company coal bed natural gas wells that discharges to the Tongue River and of Tongue River receiving water collected immediately upstream of the effluent outfall were used in WET testing. Acute toxicity tests (96 hours for fathead minnows and 48 hours for *Ceriodaphnia*) were conducted at Energy Laboratories, Inc. (2001) in Billings Montana, from March 22 through March 26, 2001, in accordance with Region VIII EPA guidelines. Six dilutions were used during WET testing with percent effluent in each dilution at 0 percent (pure receiving water control), 12.5 percent, 25 percent, 50 percent, 75 percent, and 100 percent (pure effluent). The effluent passed the 50 percent mortality test for both species tested, indicating there would be no mortalities at equal parts of effluent (or less) and receiving river water. At effluent levels of 75 and 100 percent, fathead minnow survival after 96 hours was 85 percent and 60 percent, respectively. *Ceriodaphnia* survival after 48 hours at effluent levels of 75 and 100 percent was 95 and 80 percent, respectively (Energy Laboratories, Inc. 2001). These test results generally indicate some mortalities of fish and insects could occur when the volume of effluent constitutes more than 50 percent of the flow in a drainage.

The abandonment of exploratory and producing wells would have few, if any, direct or indirect impacts on aquatic resources. Activities that impact aquatic habitat and biota during CBM exploration and production phases would cease with CBM abandonment. Any associated long-term effects on aquatic resources from these discontinued activities, such as sediment delivery from roads, would gradually subside as disturbed areas are reclaimed.

Special Status Species

The federally endangered pallid sturgeon, two federal candidate species (Montana Arctic grayling, Warm Springs Zaitzevian riffle beetle), and two fish species (sicklefin chub, sturgeon chub) not warranted for federal listing but of significant concern to the U.S. Fish and Wildlife Service are present in portions of the project area. Also present in portions of the project area are eight BLM-sensitive and/or state fish species of special concern, including blue sucker, northern redbelly dace, finescale dace, paddlefish, pearl dace, shorthead sculpin, shortnose gar, westslope cutthroat trout, and Yellowstone cutthroat trout. Distribution of these species was described in Chapter 3 discussions of the affected environment for aquatic resources. Because of their scarcity or narrow habitat niche, these special status species may be somewhat more vulnerable to potential project effects than were described above for all aquatic resources. However, the potential for affecting any of the federally listed, candidate, significant concern, BLM-sensitive, or state species of concern would generally be similar to that described in the preceding text for other aquatic species, and would either be low or absent. For example, all water from exploration activities would be captured in tanks and not discharged to rivers. In addition, conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges. Some impacts could potentially occur, however, during extreme low or no flow conditions. Release of adequate quality water from production may improve habitat that has been degraded through water withdrawals. The range and type of other potential effects discussed above for aquatic resources also apply to special status species since they are a subset of aquatic resources. Special status species could be minimally affected through construction of stream crossings, erosion generated by construction activities, and effects of other activities discussed above for aquatic resources.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. However, regulations mentioned above related to aquatic resources would be under the jurisdiction of Tribal Laws and not state or federal laws. CBM development on the Crow Reservation is expected to be very limited. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands and would occur on a much smaller scale than on BLM or State lands. If there were no CBM development on Tribal Lands, then there is expected to be minimal impacts on aquatic resources on the reservation. CBM development in Wyoming could impact surface waters on the reservation and could have an effect on aquatic life.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative A. CBM development on the Northern Cheyenne Reservation is expected to be very limited. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands and would occur on a much smaller scale than on BLM or State lands. If there were no CBM development on Tribal Lands, then there is expected to be minimal impacts on aquatic resources on the reservation. CBM development in Wyoming could impact surface waters on the reservation and could have an effect on aquatic life. However, the pending Montana and Wyoming Water Quality Agreement would preserve the current water quality in the Tongue River and prevent Wyoming operators from discharging poor quality production water into the Tongue River. The Tongue River borders the reservation on the east.

Conclusions

Relatively few residual impacts on aquatic resources, including the special status species, would be expected from exploration activities on BLM-managed lands. Some minor, short-term impacts on aquatic resources on BLM lands may result from increased sediment delivery, possible impedance of fish movements in streams, potential for accidental spills of petroleum products, and possibly increased fish harvest. Residual impacts on aquatic resources from exploration activities on lands subject to state regulations would be similar to these impacts, although possibly slightly greater in magnitude because of the lack of mitigation measures prohibiting surface occupancy or use of water bodies, floodplains, riparian areas, and steep slopes. Expected impacts on aquatic resources on state-regulated lands would still be relatively minor because of the limited nature of exploration activities and their dispersed pattern over a large geographic area. Residual impacts from developing 250 CBM wells on the CX Ranch would include the same potentially minor kinds of impacts that were described for exploration activities on lands subject to state regulations, although they would extend over a longer period of time. The effects of discharging production water from these wells to the upper Tongue River drainage basin would cause river flow to increase from about 39 cfs to 43 cfs and river TDS concentration to increase from 284 mg/l to 378 mg/l. These increases would not be expected to impact aquatic habitat or organisms in the Tongue River. In addition, the conditions of the MPDES Permit would provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges. Discharges of CBM produced water during extreme drought conditions of no background flow (worst-case conditions) would probably provide some refuge for aquatic organisms, even though TDS concentration would be approximately 1,400 mg/l and water temperatures would initially be cool but increase. There also could be some mortalities of aquatic organisms, as indicated by results of WET testing, under these extreme conditions. The abandonment of CBM wells would have few, if any, direct or indirect residual impacts on aquatic resources. Long-term effects on aquatic resources associated with discontinued activities, such as sediment delivery from roads, would subside as disturbed areas are reclaimed. Agency mitigation measures implemented during abandonment would reduce erosion potential, prevent water quality degradation, facilitate reclamation of disturbed lands, and further reduce the potential for long-term impacts on aquatic resources, including special status species.

Cumulative Impacts

This assessment considers the potential cumulative impacts on aquatic resources resulting from the effects of the No Action Alternative together with the effects from five coal mines, two minerals/metals mines, five existing power plants, four oil and gas refineries, and two manufacturing facilities that are present within the project area. The greatest potential for impacts on aquatic resources from these other projects is probably from coal mines, both through the direct loss of habitat and the degradation of water quality. Surface water quality near coal mines is impacted by increased sediment load because of increased erosion during mining. This is mitigated by the use of sediment settling ponds and the vegetation of overburden and topsoil storage areas. The discharge of groundwater pumped from mine pits also may affect surface water quality and quantity, depending on the quality of groundwater within the mine vicinity and the quantity of groundwater discharged. Aquatic resources associated with nearby springs and surface streams within the area could be impacted by the lowering of water tables from mining activities. In some instances, mining activities impact aquatic resources by diverting streams or drainage areas that are within the area to be mined. Original topography, including stream channels and drainage areas, are restored during mine reclamation activities. Some of these same types of impacts also may occur at minerals/metals mines, but would be less likely to occur at the power plant, oil and gas refinery, and manufacturing sites.

Other possible impacts on aquatic habitat and biota from these projects include sediment delivery from access roads located near drainages, loss of riparian habitat and function along streams, and reduction in water-based recreational activities such as fishing with the loss of aquatic habitat. The nature of effects on aquatic resources from these activities would be similar to those described for potential impacts under the No Action Alternative for CBM development. Most of these impacts would be limited in area given the generally localized nature of these other projects. Their effects are typically mitigated by following standard construction and operating procedures and BMPs and by implementing reclamation activities during or following project construction, operation, and/or abandonment – the same as described for CBM development under the proposed project. For these reasons, the effects from these other projects would not be expected to result in substantive cumulative impacts on aquatic resources potentially affected by CBM development.

Regele and Stark (2000) discussed some of the possible biological issues associated with CBM gas development in Montana, including the effects of pumping and discharging production water from CBM wells into surface drainages. They reported that much of the groundwater being produced from more than 3,000 CBM-producing wells in the Wyoming portion of the Powder River Basin is being discharged into rivers that flow directly into southeastern Montana. These include the Powder and Little Powder rivers and their tributaries. Some potential short-term and long-term CBM developmental effects identified by Regele and Stark (2000) include decreased surface water availability in some areas because of groundwater pumping; increased surface water flows in areas receiving CBM discharges in other areas; and water quality effects of CBM development discharges on waters and biota receiving the CBM discharges. However, Wyoming EISs and EAs found no decrease in surface water because of aquitards between production coals and surface waters.

The *Hydrological Resources* impact analysis presented in this chapter evaluated the potential cumulative effects of full-scale CBM development and discharge of produced water to the Powder River Basin in Wyoming. That analysis recognized the substantial flow increases and associated hydrologic and water quality impacts that would occur in the Powder, Little Powder, and Tongue rivers in Montana as a result of those discharges. Impacts on aquatic habitat and biota from that magnitude of discharge also would be substantial. The *Hydrological Resources* analysis noted, however, that the Wyoming DEQ and Montana DEQ have pledged to maintain water quality in these three rivers, and that surface water discharge permits limiting the quantity of CBM-produced waters that would be discharged would mitigate impacts from Wyoming CBM on Montana rivers. This action also would mitigate the potential for cumulative impacts on aquatic resources from the effects of Wyoming CBM on Montana rivers.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

Most but not all of the same types of impacts on aquatic resources described for CBM activities under Alternative A (No Action Alternative) would occur under Alternative B. These impacts and some of their effects include the direct removal of aquatic and riparian habitat at stream crossings and near well sites, habitat degradation and loss from sedimentation, altered spawning and seasonal migration because of stream obstructions, direct loss of fish and aquatic invertebrates from accidental spills or pipeline ruptures releasing harmful substances and increased harvests of fish because of increased human access. The magnitude and geographic extent of these impacts would potentially be greater under Alternative B than Alternative A because of the activities associated with the development of an estimated 23,850 CBM production wells and 2,650 CBM dry holes. There would be an estimated 7,621 production wells and 847 dry holes on BLM-administered land, 8,849 production wells and 983 dry holes on state-regulated land, 7,200 production wells and 800 dry holes on Tribal land, and 180 production wells and 20 dry holes on U. S. Forest Service-administered land.

Impacts described under the No Action Alternative that are associated with the discharge of production water to drainages and resultant increases in stream flows and elevated levels of TDS and constituents would not occur under Alternative B. There would be a potential for the accidental spill, release, or seepage of production waters temporarily stored in holding ponds or tanks prior to their injection. However, as noted in the *Hydrological Resources* impact analysis, berms around these facilities would be designed to contain and prevent the accidental runoff to nearby drainages of stored production waters, which should minimize the potential for impacting aquatic habitat and resources.

The *Hydrological Resources* impact analysis indicates, based on the estimated groundwater depletions, those watersheds that may experience the greatest CBM development activity. The most active watersheds are projected to be the Little Bighorn and Lower Bighorn, Upper Tongue and Lower Tongue, Little Powder and Middle Powder, Mizpah, and Rosebud, where an estimated 14 to 50 percent of the groundwater resource in the coal seams within a watershed would be depleted after 20 years. Even though few impacts on aquatic resources are projected under Alternative B, data on fish species present, fisheries management policies, and fisheries resource values would be used to identify those watersheds and drainages that are probably most sensitive to the effects of CBM development and should be monitored closely during CBM activities. Based on these fisheries criteria, drainages probably most sensitive to the effects of CBM development are the Lower Bighorn, Upper Tongue, and Little Bighorn. The Lower Bighorn and Upper Tongue are managed as trout fisheries and have high fisheries resource values, while the Little Bighorn is managed for warm/cool water fish species and trout, and has a moderate fisheries resource value. The Lower Tongue, Little Powder, and Rosebud are probably less sensitive from a fisheries perspective, being managed as non-trout or undesignated fisheries, but they have high to substantial fisheries resource values. The Mizpah is probably the least sensitive of these drainages, being managed as a non-salmonid (warm water) fishery with a moderate to limited fisheries resource value.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative B would generally be similar to those described in the preceding text for aquatic resources under this alternative. Many of these effects also would be similar to those described under Alternative A. However, they would be greater in magnitude and extent because of considerably more production wells, and would primarily result from construction-related activities. No production water would be discharged to drainages under Alternative B and there would be no resultant potential for affecting special status species. The overall likelihood of affecting special status species would probably be low or absent, depending on species distribution. However, as noted for Alternative A, these species may be somewhat more vulnerable than the more commonly-occurring aquatic species because of their limited distribution, low abundance, and/or narrow habitat requirements.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. CBM development on the Crow Reservation is expected to comprise a portion of the estimated 7,200 CBM production wells to be developed on Tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were in fact no CBM development on the Crow Reservation, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the Tribe approves CBM development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative B to minimize the potential for adjacent CBM development to affect Tribal aquatic resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B. CBM development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 7,200 CBM production wells to be developed on Tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a much smaller scale than on BLM or State lands. If there were no CBM development on the Northern Cheyenne Reservation, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the Tribe approves CBM development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative B to minimize the potential for adjacent CBM development to affect Tribal aquatic resources.

Conclusions

The types of residual impacts that would persist for Alternative B are the same as described for Alternative A, with the following two exceptions. Impacts would occur on a far greater scale under Alternative B than Alternative A. Also, no CBM-produced water would be discharged under Alternative B and there would be no potential for resultant residual impacts on aquatic resources, including special status species, from that particular activity.

Cumulative impacts would be the same as described for Alternative A. In addition, the 1-mile-wide buffer around active coal mines under Alternative B would reduce the potential for cumulative groundwater drawdown impacts to result from coal mine projects.

Alternative C—Emphasize CBM Development

Impacts on aquatic resources associated with Alternative C would include all of those CBM-related impacts described for Alternatives A or B, but they would be greater in magnitude. The intensity and geographic extent of CBM exploration, production, and abandonment under Alternative C would be the same as described for Alternative B. However, Alternative C emphasizes CBM exploration and development with minimal restrictions, and it would disturb many more acres (101,000 acres short-term, 69,000 acres long-term) than Alternative B (80,000 acres short-term, 48,000 acres long-term). Alternative C contains the same set of mitigation measures as Alternative B, whose benefits were described earlier and which were listed in Chapter 2. However, unlike

Alternative B, CBM exploration and production water under Alternative C would be discharged, untreated, onto the ground's surface where it would subsequently enter surface water drainages. There would be no requirement for injecting CBM production water into the ground, for treating water prior to its discharge, or for preparing a site-specific water management plan. Discharged CBM water would be available for beneficial uses by industry, landowners, agriculture, and for wildlife if of suitable quality.

The effects of increased TDS concentrations would probably be greater on the more sensitive species of salmonids in headwater mountain streams than on native fish species in prairie streams that have evolved in an environment of naturally higher TDS levels. In addition, sensitive species of salmonids and non-native warm water fish that have not evolved in highly saline water but that now reside in prairie streams also would be at risk. These species may be particularly vulnerable because TDS levels are generally already high in prairie streams, thereby increasing the potential for TDS-related impacts from CBM production.

Regele and Stark (2000) discussed impacts on aquatic resources resulting from CBM effects on drainage hydrology and water quality that would probably have the greatest likelihood of occurring under Alternative C. Potential impacts from reduced surface water availability would probably be limited to the unlikely event of a very localized connection between a spring-fed stream and groundwater withdrawals. This could possibly result in the reduction or loss of springs and flowing reaches of stream channels that provide habitat for native flora and fauna in southeastern Montana. Regele and Stark (2000) cited studies by the MFWP that recognized the importance of perennial and intermittent prairie streams in the life history of native fishes, by providing spawning and rearing habitat for mainstem fish species. The effects of increased flows from CBM discharges would include channel erosion, soils and vegetation loss, increased sediment load and sedimentation, and degraded water quality; these effects would directly and indirectly impact fish, amphibians, aquatic invertebrates, and algae. Also, if great enough, increased TDS and salinity levels in streams receiving CBM discharges would affect fish and aquatic invertebrates, especially those species not well adapted to high TDS levels, such as salmonids found in higher-elevation streams. Regele and Stark (2000) cited studies that showed TDS concentrations should not be increased above 1,200 micromhos if a water's "excellent biological health characteristics are to be preserved." The potential development of saline seeps down-gradient of CBM holding ponds also would affect aquatic resources present in streams receiving these discharges. Regele and Stark (2000) cited the MFWP, which concluded that because of the limited fisheries habitat available in the arid environment of southeastern Montana, great care must be taken where there is a potential to degrade aquatic resources.

The *Hydrological Resources* impact analysis in this chapter estimated that 0.67 billion cubic feet of CBM water would be discharged to the Montana portion of Powder River Basin drainages each year. This is equivalent to an additional, total year-round basin flow of 21 cfs and assumes a 70 percent conveyance loss prior to discharges reaching drainages. The *Hydrological Resources* impact analysis showed that resultant flow increases over base flows would average less than 1 percent in most of the Powder River Basin drainages. The largest percent base flow changes would occur in the Little Powder and Rosebud drainages, which are managed as non-trout, undesignated fisheries and have high or substantial fisheries resource values. Rosebud Creek has been proposed to be classified as a cold water fishery by the Northern Cheyenne Tribe. It supports northern pike and rainbow trout (FWS 1980). This additional volume of water in Powder River Basin drainages would not be expected to impact larger drainages or their water temperatures, but it would impact smaller perennial, intermittent, and ephemeral drainages, especially if peak discharges of CBM water to smaller drainages greatly exceed this annual average. Water quality would be impacted much more than water quantity from CBM discharges because of the considerably higher TDS and constituent concentrations typically found in CBM-produced water than in surface drainages. The *Wildlife* impact analysis in this chapter notes that the potential for impacting water quality by discharging CBM production water with high salinity and sodicity would be greatest in smaller perennial and intermittent drainages during low-flow periods of the year. The effects of high TDS and constituent concentrations on aquatic organisms were discussed under Alternative A.

The temperature of the smaller perennial, intermittent, and ephemeral receiving water bodies may also be affected by the increased groundwater discharge associated with this alternative. The resultant temperature change and potential for affecting aquatic resources would depend on a number of variables that would have to be determined on a site-specific basis, such as volume and temperature of production and receiving water, time of year, species present and their thermal tolerances, and life history considerations. In the event of reduced water temperatures in receiving waters, any resultant adverse effects would tend to be greater in those systems or portions of systems (for example, downstream reaches) dominated by species with warm water thermal preferences.

Surface discharges of CBM-produced water would be subject to Montana DEQ MPDES Permit requirements and limitations for discharge into identified watersheds. The volume of CBM production water potentially discharged to the Powder River Basin drainages in Montana that were listed in the *Hydrological Resources* impact analysis has a greater potential for causing sediment, flow, and water quality-related impacts on aquatic resources than the effects of Alternatives A or B. However, these effects would be within the range of acceptable limitations stipulated under the various MPDES Permits that would have to be issued under Alternative C. For this alternative to be viable, conditions of the MPDES Permits must be able to provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges.

Special Status Species

The types of impacts and potential project effects on federally listed, candidate, significant concern, BLM-sensitive, and state species of concern under Alternative C would generally be similar to those described in the preceding text for aquatic resources under this alternative. Special status species would potentially be affected by changes in the quantity and quality of receiving waters from discharges of CBM-production water, construction of stream crossings, erosion generated by construction activities, and effects of other activities discussed above for aquatic resources. Since production water would not be held in tanks or improved in quality, that which reaches the Tongue, Little Powder, and Powder Rivers would likely have increased SAR values that could affect the quantity and quality of receiving waters, especially during low or no flow conditions, as well as food sources for special status species. One special status species possibly present in downstream reaches of several of these drainages and found in the Yellowstone River within the Powder River RMA that is potentially at risk is the federally-listed, endangered pallid sturgeon. Other special status species occupying similar habitat types in these particular waters also may be at risk. There also is the potential for affecting the two federal candidate species (Montana Arctic grayling and the Warm Springs zaitzevian riffle beetle) because of the nature of CBM exploration and development activities that would occur under Alternative C. However, the likelihood of risk is probably low because grayling are generally found at relatively high, cold headwater locations in the Gallatin River and the Clarks Fork within the project area, and the riffle beetle is found in a single warm spring near the City of Bozeman. Minimizing or avoiding activities in these specific areas to the extent possible would minimize the potential for affecting these candidate species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C. CBM development on the Crow Reservation is expected to comprise a portion of the estimated 7,200 CBM production wells to be developed on Tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were in fact no CBM development on Tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Unlike Alternative B, there would be no restrictive buffer zone around the reservation under Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative C. CBM development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 7,200 CBM production wells to be developed on Tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. Unlike Alternative B, there would be no restrictive buffer zone around the reservation under Alternative C.

Conclusions

The types of residual impacts that would persist for Alternative C are the same as described for Alternative A, but they would occur on a far greater scale. In addition, a large volume of CBM-produced water would be discharged under Alternative C and there would be a potential for resultant residual impacts on aquatic habitat and organisms, including special status species, from that particular activity. One of the most noteworthy potential effects of this alternative on special status aquatic species would be possible risks to the endangered pallid sturgeon.

Cumulative impacts would be the same as described for Alternative A. Unlike Alternative B, there would be no buffers around active coal mines or Indian reservations to minimize the potential for inter-related effects.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on aquatic resources associated with Alternative D would include all of those CBM-related impacts described for Alternatives A and/or B, but they would be greater in magnitude. The intensity and geographic extent of CBM exploration, production, and abandonment and the acres of land disturbed in the short-term and long-term under Alternative D would be the same as described for Alternative B. However, Alternative D encourages CBM development while maintaining existing land uses and protecting downstream water consumers. Alternative D, like Alternative B, contains the same set of mitigation measures designed to avoid, minimize, or mitigate the impacts of CBM development activities on aquatic resources. However, unlike Alternative B, CBM-produced water (depending on water quality) would be treated, prior to its discharge or storage in holding facilities, so that the effluent meets standards established by the Montana DEQ for downstream uses. Beneficial uses of produced water would be allowed and treatment would vary based on industrial, municipal, agricultural, and wildlife uses. Treated, produced water would be discharged to drainages by pipeline or constructed watercourses to avoid the potential for erosion and sediment-related impacts on aquatic resources. The treatment of produced water prior to its discharge to surface drainages through constructed facilities would greatly reduce the potential for elevated TDS, salinity, and sodicity levels described for Alternative C.

The *Hydrological Resources* impact analysis estimated that 2.24 billion cubic feet of CBM water would enter the Montana portion of Powder River Basin drainages each year. This is equivalent to an additional, total year-round basin flow of 71 cfs and assumes no conveyance losses because of the use of pipelines or constructed water courses to convey discharges. The *Hydrological Resources* impact analysis showed that resultant flow increases over base flows would average 1 percent in Powder River Basin drainages. The greatest increase in base flows (approximately by a factor of 4) would occur in the Little Powder and Rosebud drainages, which would impact aquatic habitat and organisms through the same mechanisms described under Alternative A. This volume of water would not be expected to impact larger drainages, but it would impact other smaller perennial, intermittent, and ephemeral drainages, especially if peak discharges of CBM water to smaller drainages greatly exceed this annual average. There would also be a potential for adverse temperature-related effects on warm water fish species if there is a reduction in receiving water temperature in these smaller drainages. Otherwise, water quality of these streams would not be impacted by discharged water since it would have been treated. As noted for Alternatives A, B, and C, conditions of the MPDES permits issued under Alternative D must be able to provide legally enforceable assurances that water quality, aquatic resources, and the beneficial uses of receiving waters would not be degraded by production water discharges.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative D would generally be similar to those described in the preceding text for aquatic resources under this alternative. Many of these effects also would be similar to those described under Alternatives A and B, except they could be greater in magnitude because of the discharge of treated production water to drainages under Alternative D. Special status species potentially most vulnerable to project-related effects would include those in smaller perennial and intermittent drainages within the Powder River Basin. The overall likelihood of affecting special status species would probably be low or absent, depending on species distribution. However, as noted for the other alternatives, special status species may be somewhat more vulnerable than the more commonly-occurring aquatic species because of their limited distribution, low abundance, and/or narrow habitat requirements.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D. CBM development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBM production wells to be developed on Crow Tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBM development on Tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the Tribe approves CBM development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative D to minimize the potential for adjacent CBM development to affect Tribal aquatic resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative D. CBM development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 3,600 CBM production wells to be developed on Northern Cheyenne Tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBM development on Tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the Tribe approves CBM development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative D to minimize the potential for adjacent CBM development to affect Tribal aquatic resources.

Conclusions

The types of residual impacts that would persist for Alternative D are the same as described for Alternative A, with the following two exceptions. Impacts would occur on a far greater scale under Alternative D than Alternative A. Also, CBM production water discharged under Alternative D would be treated. Except for possible water temperature changes in smaller drainages, there would be no potential for residual water quality impacts on aquatic resources, including special status species, from that particular activity.

Cumulative impacts would be the same as described for Alternative A. In addition, the 1-mile-wide buffer around active coal mines and the 2-mile-wide buffer around Indian reservations under Alternative D would reduce the potential for cumulative inter-related impacts to occur.

Alternative E—Preferred Alternative

Impacts on aquatic resources associated with Alternative E (the Preferred Alternative) would generally be comparable to the CBM-related impacts described for Alternative B, which emphasizes the protection of natural and cultural resources. The number of CBM wells developed would be the same as under Alternative B although more land would be disturbed under Alternative E in the short-term (99,000 acres) and the long-term (59,000 acres).The objective of Alternative E is to manage CBM development in an environmentally sound manner while sustaining existing land uses. To meet this objective, Alternative E contains requirements designed to protect hydrologic resources by combining management options of CBM-produced water so that no degradation of water quality, including thermal criteria, would be allowed in any watershed. These options include, but are not limited to, industrial, municipal, agricultural, and wildlife beneficial uses, as well as injection, treatment, impoundment, and discharge of CBM water. CBM operators would be required to develop a Water Management Plan as part of their overall Project Plan that describes how impacts on surface resources resulting from exploration and production activities would be minimized or mitigated, and how a discharge (if proposed by the operator) could occur without damaging the watershed-in accordance with a required and approved MPDES Permit and MDEQ water quality laws. The Project Plan would be prepared in consultation with the affected Indian tribes, affected surface owners, and other involved permitting agencies according to guidelines to be developed by the BLM and State of Montana. The lack of transportation corridor requirements under Alternative E would result in greater surface disturbances and possibly increased sediment delivery to nearby drainages compared to Alternative B. However, because of the overall beneficial effect of protective measures, including the mitigation measures described earlier, relatively few impacts on aquatic resources would be expected under Alternative E. Aquatic resources in the same watersheds and drainages identified under Alternative B as being most sensitive to CBM development also should be monitored closely during CBM activities under Alternative E.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative E (the Preferred Alternative) would generally be similar to those described in the preceding text for aquatic resources under this alternative. Requirements designed to protect hydrologic resources by combining management options of CBM-produced water so that no degradation of water quality would be allowed in any watershed would benefit special status species. The lack of transportation corridor requirements under this alternative would result in comparatively greater surface disturbances than under Alternative B and possibly increased sediment delivery to nearby drainages. However, because of the overall beneficial effect of protective measures, relatively few impacts on special status species would be expected under Alternative E. The same watersheds and drainages identified under Alternative B as being most sensitive to CBM development also should be monitored closely during CBM activities under Alternative E.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E. CBM development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBM production wells to be developed on Crow Tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBM development on Tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. To determine potential impacts to the Crow Reservation from CBM development on lands adjacent to the reservation, monitoring wells would be installed during the exploration phase on all BLM-administered oil and gas estates that adjoin reservation boundaries in Montana. If monitoring indicates drawdown would occur on the reservation, mitigation such as the operator providing a hydrologic barrier, communitization agreement, or spacing that would protect Indian minerals from drainage, would be required.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative E. CBM development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBM production wells. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBM development on Tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative E are similar to those for Alternative B. These impacts would be essentially the same as described for Alternative A, except that impacts would occur on a far greater scale and there would be no potential for resultant residual impacts on aquatic resources, including special status species, associated with the disposal of CBM-production water.

Cumulative impacts would be the same as described for Alternative A.

CHAPTER 5

CONSULTATION & COORDINATION

CHAPTER 5: CONSULTATION AND COORDINATION

Introduction

The Montana Statewide Oil and Gas Environmental Impact Statement (EIS) and Amendment of the Powder River and Billings Resource Management Plans (RMPs) was prepared by an interdisciplinary team of specialists from the Bureau of Land Management's (BLM's) Miles City Field Office and Billings Field Office, the Montana State Office of the BLM, the State, and the consulting firms of ALL Consulting and CH2M HILL under contract to the BLM.

Consultation, coordination, and public involvement occurred during the process through public scoping meetings, informal meetings, individual contacts, newspaper releases, and *Federal Register* notices.

Preparation of the document began in January 2001. Data that was used came from inventories conducted before that time, from information received from the public and other agencies, and knowledge of the field office specialists.

Public Participation

A public participation plan was prepared to provide management and team guidance for developing the RMP EIS and Amendment, and to ensure public involvement during the entire document preparation process. During the scoping of the EIS, formal and informal public input was encouraged and sought.

A *Federal Register* notice was published on December 19, 2000, informing the public of the notice of intent to plan and announcing the notice of availability for the planning criteria.

Several news releases were published in local papers, announcing the beginning of the plan, encouraging public involvement, and publicizing the availability of the planning criteria.

Brochures were mailed to over 1,000 individuals, groups, and agencies in December 2000 notifying the public of the expected issues and upcoming public scoping meetings. A *Public Comment Summary and Recommendations Report* was prepared and made available electronically and in hardcopy in March 2001. This report summarizes the comments received from the public scoping meetings.

Public scoping meetings were conducted at five towns in the planning area with a total attendance of 329 people. Individual meetings were held with Crow and Northern Cheyenne Native American Tribes.

A total of 311 written communications, with more than 2,100 comments, were received after the public scoping meetings. Most of these written comments reiterated oral comments from the public meetings. Oral and written comments covered a spectrum of issues, but the majority were concerned with resource management of water, lands, air, and wildlife resources. The issues identified are presented in Chapter 1. Records of public comments and concerns are on file in the BLM Miles City Field Office.

In January 2002, approximately 1,500 copies of the draft RMP EIS and Amendment were distributed for public comment. Additionally, a copy was posted on the Montana Department of Environmental Quality's (MDEQ's) web site for public downloading. A *Federal Register* notice was published February 15, 2002, beginning the comment period on the draft. The comment period on the DEIS closed May 15, 2002.

Public hearings were held to gather comments on the draft RMP EIS and Amendment at six locations in the planning area.

PLACE	DATE	ATTENDANCE
Broadus	April 1, 2002	50
Billings	April 2, 2002	173
Crow Agency	April 3, 2002	48
Lame Deer	April 3, 2002	160
Helena	April 4, 2002	94
Bozeman	April 9, 2002	194
Total		**719**

Transcripts from the public hearings are available on the BLM Miles City Field Office Internet site at http://www.mt.blm.gov/mcfo.

What has Changed in Chapter 5 Since the Draft EIS?

Chapter 5 documents the public participation—as well as agency and tribal consultation and coordination—during the preparation of this Environmental Impact Statement (EIS). A detailed list of Tribal coordination dates and meetings is provided. The most significant addition is the list of the public's comments, along with the agency responses. Comments and responses are provided for each resource topic. To be consistent with the rest of the document, the resource topics are presented in alphabetical order.

Consultation with U.S. Fish and Wildlife Service on Threatened and Endangered Species

As required by Section 7 of the Endangered Species Act (ESA) of 1973, the BLM prepared and submitted a biological assessment to the U.S. Fish and Wildlife Service (FWS). This document defined potential impacts on threatened and endangered species as a result of management actions proposed in this RMP EIS and Amendment. A letter received September 4, 2002, from the U.S. Fish and Wildlife Service states:

> "We concur with your determinations that the proposed action is likely to adversely affect the threatened bald eagle, and the proposed mountain plover. Although the BLM has determined that implementation of proposed changes in coal bed methane is likely to affect the black-tailed prairie dog *(Cynomys ludovicianus)*, we concur with your determination that the action is not likely to adversely affect the black-footed ferret (*Mustela nigripes*).
>
> "This concurrence is based upon the BLM's commitments to 1) locate project activity to avoid impacts on prairie dog colonies that meet FWS criteria as black-footed ferret habitat (FWS 1989), 2) conduct ferret surveys in suitable habitat, following current lease stipulations for oil and gas development, and 3) if a black-footed ferret or its sign is found during a survey, all development activity would be subject to recommendations from the *Montana Black-footed Ferret Survey Guidelines, Draft Managing Oil and Gas Activities in Prairie Dog Ecosystems with Potential for Black-footed ferret Reintroduction* and re-initiation of Section 7 Consultation with the Service.
>
> "The Service also concurs with your determination that the action is not likely to adversely affect the threatened Ute ladies'-tresses orchid (*Spiranthes diluvialis*), the pallid sturgeon *(Scaphirhynchus albus)*, and the Montana arctic grayling *(Thymallus arcticus)*. The Service gives its concurrence to BLM's determination of "no effect" for the Canada lynx *(Lynx canadensis)*, gray wolf *(Canis lupus)*, interior least tern *(Sterna antillarum athalassos)*, and the warm spring zaitzevian riffle beetle *(Zaitzevia thermae)* (FWS 2002).

A copy of the letter is included in the Wildlife Appendix of the Final EIS (FEIS).

The following is a record of correspondence between BLM and the USFWS for section 7 consultation .

02/23/01	BLM Project Notification and Request for Species
04/20/01	USFWS Response to BLM Letter Dated 2/23/2001, Request for Species
02/08/02	BLM Request for USFWS Review of Draft Biological Assessment
04/10/02	BLM Request for USFWS Review of Biological Assessment and Initiation of Formal Consultation
09/10/02	USFWS Biological Opinion Issued to BLM

Consultation and Coordination with Native American Tribes

The following list includes BLM's consultation and coordination efforts with the Tribes in preparing the draft and final EISs. The list does not include routine phone calls. For example, teleconference calls were held biweekly with the co-leads and cooperating agencies during preparation of the Draft EIS (DEIS) and monthly while preparing the FEIS.

Crow Tribe

02/28/01	EIS coordination meeting with the Crow Tribe in Crow Agency about tribal minerals.
06/12/01	EIS meeting with Crow Tribe and their lawyers to discuss the Memorandum of Understanding for becoming a Cooperating Agency.
10/24/01	Air and water teleconference call with co-leads and co-operators to discuss modeling.
04/03/02	Draft EIS public hearing in Crow Agency.
07/12/02	Meeting in Billings with Crow Tribe, Barrett Energy, and BLM to discuss development agreement and the Crow Tribe's development plans.

08/08/02	EIS consultation meeting with BLM in Billings to discuss the EIS and their narrative report.
11/02/02	Preliminary Final EIS meeting with the BLM and Crow representatives to discuss tribal comments.

Northern Cheyenne Tribe

02/14/01	EIS meeting in Billings to discuss the draft Memorandum of Understanding for the tribe to become a Cooperating Agency.
04/10/01	EIS coordination meeting in Lame Deer.
04/27/01	Coordination meeting with Northern Cheyenne and BIA in Billings to discuss water rights.
06/14/01	Teleconference call with Northern Cheyenne and BIA on Memorandum of Understanding for the EIS.
07/25/01	EIS consultation meeting in Lame Deer at the BIA office.
07/30/01	EIS coordination meeting in Billings Northern Hotel with the Northern Cheyenne Tribal Council, BLM, and BIA.
07/31/01	Teleconference call to discuss the ethnographic contract with BIA and the Northern Cheyenne tribal attorney.
08/01/01	Teleconference call with Northern Cheyenne, contractors, U.S. Environmental Protecting Agency (EPA), U.S. Geological Survey (USGS), BIA, MDEQ, Montana Bureau of Mines & Geology (MBMG), and ALL Consulting to discuss water methodology.
09/03/01	EIS consultation meeting with the Northern Cheyenne.
09/24/01	EIS meeting with the Northern Cheyenne attorney in Billings.
10/02/01	EIS meeting in Billings with the Northern Cheyenne Tribe, Crow Tribe, MDEQ, Montana Bureau of Oil & Gas Conservation (MBOGC), and BIA to discuss Chapters 3 and 4 and mitigation measures.
10/03/01	EIS meeting to continue discussion on Chapters 3 and 4 and mitigation measures.
10/24/01	Teleconference call with co-leads and co-operators to discuss air and water modeling.
04/03/02	Draft EIS public hearing in Lame Deer.
04/30/02	EIS consultation meeting in Lame Deer.
05/10/02	EIS consultation meeting in Billings.
06/07/02	EIS meeting in Billings with Northern Cheyenne and BLM's Montana State Office to discuss narrative report and mitigation appendix.
06/20/02	Meeting in Billings with Northern Cheyenne and BLM's Washington, D.C. Office to discuss Northern Cheyenne's concerns regarding water quality and methane development in Montana and Wyoming and its effect on tribal assets.
08/27/02	Coordination meeting in Billings to discuss Northern Cheyenne mitigation options.
11/02/02	Preliminary Final EIS meeting with the BLM and Northern Cheyenne to discuss tribal comments.

The Lower Brule Tribe from South Dakota also expressed concerns after the DEIS was released to the public for review. BLM met with tribal representatives in Billings on August 14, 2002, to discuss their concerns and the preparation of the preliminary FEIS.

Consistency

The BLM's planning regulations require that resource management plans "be consistent with officially approved or adopted resource related plans, and the policies and programs contained therein, of other Federal agencies, State and local governments, and Indian tribes, so long as the guidance and resource management plans are also consistent with the purposes, policies, and programs of Federal laws, and regulations applicable to public lands...." (43 CFR 1610.3-2)

All federal, state, and local agencies and Tribal councils have been requested to review this document and inform the BLM of any inconsistencies with their plans.

The Montana Governor's clearinghouse will be supplied with copies of the final document for review to ensure consistency with the state's plans.

Comments and Responses

The BLM, MDEQ, and MBOGC received more than 18,000 e-mails, faxes, letters, cards and oral statements during the public comment period. Of those, approximately 8,800 commented on the Montana EIS, while the remainder commented on the Wyoming EIS. The Wyoming comments were forwarded to the BLM field office in Buffalo, Wyoming, for consideration.

From the 8,800 Montana communications, more than 25,000 comments were made on the DEIS. In preparing the FEIS, approximately 75 percent of those comments were used to accomplish the following:

- Modify analysis
- Develop and evaluate analysis not previously considered by the agency
- Supplement, improve, or modify the analysis
- Make factual corrections
- Explain why the comments do not warrant further agency response

The remaining comments expressed a preference or opinion that did not affect the analysis. These were carefully considered in the decision-making process for developing the FEIS. Records of all comments are available at the BLM Miles City Field Office.

Comments that were incorporated into this analysis for the FEIS are included in this chapter, grouped by topic area. Comments that addressed multiple topics were placed under the predominant concern or issue. In the comments the word "Chapter" refers to "Chapters in the DEIS." **Any comment that contains a reference to a specific page, table, map, or figure refers to the DEIS document.** Each comment is then followed by a discussion or response. Responses refer to the FEIS. Text revisions to the FEIS often were considered to be the appropriate response, and this is noted where applicable.

Alternatives and Other Management Concerns

Comments and Responses

Comment 1 (C-1): The Environmental Protection Agency, Region 8, Denver, Colorado Office has not rated the Draft EIS with regards to the potential environmental impacts because, in their opinion, the document does not present sufficient information to understand the impacts of the Preferred Alternative. However, the EPA has issued a rating regarding the adequacy of the information provided in the Draft EIS. The rating attached to this issue is category 3 (Adequacy of Impact Statement–Inadequate). The basis for the EPA rating is the lack of specifically identified, economically and technically feasible water management practices for each watershed that are adequate to assure attainment of water quality standards under the Clean Water Act.

Response 1 (R-1): The FEIS has been augmented with a water management table and a new section under each alternative to outline the number of potential management facilities required in each watershed. Each management option is currently being used in the region and therefore is technically achievable and fiscally operational.

C-2: Previously issued gas leases in the Powder River Basin, which were analyzed using BLM's existing land use plans under the National Environmental Policy Act (NEPA), are moot because BLM's field offices "rely on outdated environmental reviews that predate coal bed methane" and are now judged invalid based on a ruling by the Interior Department's Board of Land Appeals favoring a claim by the Wyoming Outdoor Council (*Billings Gazette*, May 4, 2002). BLM should have considered leasing decisions and stipulations for CBM development in the DEIS.

R-2: The BLM completed the *Miles City District Final Oil and Gas RMP/EIS Amendment* in December 1992 and completed the Record of Decision (ROD) for this RMP/EIS in February 1994 (1994 Amendment). The 1994 Amendment was developed to make sure BLM's oil and gas leasing program was in compliance with *James R. Conner, et al. v. Robert Burford, et al.* No. 85-3929, Ninth Circuit. A deliberate effort was completed (September 1990 Coal Bed Methane Management Situation Analysis Document) to consider coal bed methane (CBM) development activities as part of the Reasonably Foreseeable Development (RFD) scenario used to analyze the impacts of leasing federal oil and gas estates. A limited level of CBM exploration and development activity was included in the RFD for the 1994 Amendment based on existing and anticipated CBM activity in Wyoming and Montana. The 1994 Amendment clearly recognized that more analysis would be required before large-scale development of CBM could be approved. This statewide EIS meets the requirements identified in the 1994 Amendment. The Interior Board of Land Appeals decision applies to three leases in Wyoming.

C-3: The Park County Commissioners and numerous residents request the BLM consider completing a supplemental EIS on CBM development in the Bozeman Pass area of Park and Gallatin counties. There is concern that the DEIS does not adequately address the possible impacts and mitigation of those impacts as they relate to the Bozeman Pass area. Bozeman Pass is different geologically, hydrologically, socially, and economically from the Powder River area and should be studied as a separate entity.

R-3: The planning level analysis conducted for this EIS is statewide. The State will require that site-specific impacts in the Bozeman area be addressed when a company makes an application for wells on state minerals. BLM does not anticipate any federal wells being drilled.

State agencies agree that any Montana Environmental Policy Act (MEPA) review document prepared for the development of a CBM production project in the Bozeman Pass area will address site-specific information about Bozeman Pass or similar areas in Park and Gallatin counties. The agencies note that other areas of the state may also require an additional detailed site-specific environmental documentation, including EISs, following agency preparation of MEPA and National Environmental Policy Act (NEPA) screening documents for site-specific proposals.

C-4: The DEIS does not seriously consider alternatives to conserve energy that would render the need for CBM development unnecessary. Such alternatives could include ways to develop more fuel-efficient automobiles and a focus in energy policy on renewable resources like wind, solar, super insulation, geothermal, and photo voltaics. We should be looking into other renewable alternatives for energy production.

R-4: The purpose and need for the document is to analyze the effects from CBM and conventional oil and gas development (see Chapter 1 under Purpose and Need). Alternative management to existing management must meet the Purpose and Need for completing the plan. See Chapter 2 in the section Alternatives Considered But Not Analyzed in Detail for a full explanation.

C-5: The nine studies omitted from the DEIS are critical to understanding the impacts of CBM. These studies must be made available for public review and comment. It is vital that development be postponed until all studies necessary for the analysis are completed.

R-5: The Ethnographic Study, Air Modeling, 3-D Groundwater Model for Hanging Woman, and the two tribal reports from the Crow and Northern Cheyenne tribes have been completed and are summarized and referenced in the FEIS. These studies are available on the BLM and MDEQ CBM web sites. When information from any study becomes available, the RMPs are reviewed to determine if the new information warrants a change to the plan. The results of the studies have been considered in the FEIS analysis for the level of development considered.

C-6: Because the two BLM EISs for Montana and Wyoming were not combined, they do not reflect the real impact to the Powder River, Tongue River, and Yellowstone River drainages.

R-6: The cumulative impacts on shared rivers (Tongue, Powder, and Little Powder rivers) from Wyoming and Montana CBM development was considered in the surface water quality model as presented in the FEIS Hydrology section of Chapter 4. Additionally, Montana and Wyoming developed a state-to-state Water Management Agreement for water discharges, which is presented in the Hydrology Appendix.

C-7: Why were the two draft EISs—for Wyoming and Montana—not combined into one analysis? Agencies violated NEPA by failing to consider connected, similar, and cumulative actions in the same NEPA document.

R-7: The BLM considered the option of completing a single EIS for Wyoming and Montana. However, the proposed development of CBM in Wyoming and CBM predictions in Montana was not evaluated in a single NEPA document for many reasons. The purpose of and need for the proposed actions in Wyoming and Montana differ substantially. The analysis documented in the Wyoming EIS responds directly to a Proposed Action submitted by oil and gas companies. BLM in Montana received no Proposed Action from oil and gas companies and is completing the EIS to plan for potential development proposals. The Montana EIS is designed to meet the requirements of MEPA and the analysis area is more than just the PRB. By preparing two EIS documents, the differences in proposed actions and state requirements could be dealt with in a more specific fashion, resulting in impact analyses that are clearer and state applicable. When the appropriate area for the analysis of cumulative effects includes Wyoming, or other states, the EIS includes such analysis and considers the CBM development activity forecast in Wyoming.

C-8: The DEIS only analyzes CBM activities and not conventional oil and gas activity.

R-8: Conventional oil and gas development is analyzed in the DEIS. During the scoping period for the DEIS, conventional oil and gas was not raised as an issue. Therefore, no alternatives for conventional oil and gas were developed. One can find conventional oil and gas and its analyses under the Management Common to All Alternatives sections in Chapters 2 and 4. Impacts from conventional oil and gas are also analyzed as part of the cumulative impact analysis at the end of each resource topic discussion in Chapter 4.

C-9: The EIS purports to be a statewide planning document for the State for management of its CBM resources. Yet the document contains little information and analysis about any areas beyond the 16-county CBM emphasis area.

R-9: The EIS emphasizes the 16-county area because that is the area, or affected environment, with the highest CBM development potential. The planning level decisions are applicable to other areas with CBM development outside of the emphasis area. Emphasizing this known development area allows for evaluating the majority of circumstances that will be encountered during development.

C-10: MEPA disallows the revision, the issuance of supplemental information, or the drafting of additional chapters, which are intended to "fix" a faulty document "after the fact" for inclusion in a final EIS.

R-10: Changes include clarification of the preferred alternative and accompanying analyses. A certain level of change is expected between the draft and final as part of the MEPA process.

C-11: One flaw in the analysis is the lack of a "no action" alternative for CBM activities; all alternatives provide for CBM activities at some level, from test wells to full-field development.

R-11: The "no action" alternative in the document is Alternative A—No Action (Existing Management). Areas where oil and gas development are not allowed were considered and analyzed in past planning documents, including the 1994 Oil and Gas Amendment and the 1999 Area of Critical Environmental Concern Amendment.

C-12: The EIS is inadequate because it doesn't meet the requirement for agencies not to make unsupported conclusions and assumptions regarding impacts without referencing the data and rationale supporting such conclusions and assumptions.

R-12: Where information is lacking, assumptions must be made in order to analyze predicted impacts. Assumptions used in the EIS were developed by the BLM and State professionals' best judgment and experience, and from existing data and information. The assumptions, analyses and impacts will be monitored to determine if they are correct. Adjustments to planning decisions and management actions will be made as needed from the monitoring data.

C-13: Agencies don't meet NEPA requirements by deferring site-specific analyses of environmental impacts to later stages of development when it is possible to evaluate those impacts at the present time.

R-13: The EIS analyzes potential impacts from typical actions associated with CBM activities that may occur. The analysis is designed to provide the decision makers and the public with an understanding of the potential consequences and impacts on the environment from implementing certain management actions. Site-specific analyses will be conducted for site-specific project proposals.

C-14: A federal policy addressing the Missouri Breaks River National Monument states, "All federal lands within the boundaries of this monument are hereby appropriated and withdrawn from all forms of entry, leasing, and patent undermining laws from disposition under all laws relating to mineral and geothermal leasing subject to valid existing rights." Why doesn't the EIS address this federal policy?

R-14: The referenced federal policy applies only to the Missouri Breaks National Monument. The monument is outside the federal planning area of this EIS. Conversely, decisions and management actions that result from this EIS will not apply to federal lands within the Missouri Breaks National Monument.

C-15: Loss of forest on the Northern Cheyenne Reservation could cause one of the Northern Cheyenne Tribe's major funding sources to lose an annual average of $570,000 from stumpage payments. This could affect the tribal budget for employment, operating costs, and services to the tribal membership. It also could mean an annual average loss of $600,000 for our tribal forestry program. The tribe's sawmill and the Tongue River Lumber Company could also be highly affected, both by reduced income and employment.

R-15: The analysis in the EIS does not show any direct or indirect impacts to Northern Cheyenne Tribe's forest, logging program or sawmill operation.

C-16: Will there be times during high fire danger when no CBM activity should take place, and who will determine this?

R-16: During times of extreme high fire danger, the federal agencies and the State have placed restrictions, including closures, on all activities that may start fires. CBM operators would need to comply with these restrictions or operating requirements.

C-17: What steps would be taken to prevent the hazards associated with CBM from occurring, and what agency would be responsible for enforcing those measures?

R-17: Agencies with permitting authority and responsibility, such as BLM, Montana Board of Oil and Gas Conservation and Montana DEQ, would impose operating requirements as part of approved permits. The operating requirements represent Best Management Practices (BMPs) and mitigation measures designed to minimize or eliminate hazards associated with CBM operations. The EIS contains many of the BMPs and mitigation measures the agencies and companies could choose from to address the hazards. The agencies would conduct inspections to determine compliance, evaluate the effectiveness of BMPs and mitigation measures, assess impacts and require changes in operations as needed based on information gained from the inspections.

C-18: Will any fire related to CBM activities be the liability of the operator? How will this be enforced in terms of compensation to landowners, county fire departments, and local governments for fire suppression on CBM-related fires? Are the developers required to have insurance to cover this?

R-18: Current laws and regulations have provisions for requiring fire suppression cost reimbursement from anyone who can be proven to have started a wildfire. CBM operators are not exempt from these provisions. CBM developers are not required to obtain any additional fire insurance beyond that required for a conventional oil and gas operator.

C-19: The development of CBM in southeastern Montana has the potential to severely impact the physical, social, fiscal, and cultural environment of the reservation. The Northern Cheyenne Tribe does not feel that the DEIS adequately addresses these impacts in a responsible manner, nor does it offer any form of responsible mitigation to alleviate or prevent these impacts.

R-19: The Final EIS includes information provided by the Northern Cheyenne Tribe. See Chapters 2, 3 and 4 and the Northern Cheyenne Mitigation Appendix.

C-20: None of the alternatives analyzed in detail in the DEIS includes orderly, phased development of CBM wells. Phased development involves the concept of clustering development geographically to maximize and allocate the recovery of resources and use a common infrastructure. Clustered development facilitates an increase in planning over larger areas and may facilitate injection of CBM-produced water into depleted portions of the same aquifer. Phased development also should involve developing one coal seam at a time

R-20: The Alternatives were developed based on the purpose and need of the EIS and the scoping comments submitted by the public. Many of the points, such as minimizing surface disturbance, reclamation, protecting wildlife and habitat, and surface owner agreements, are addressed in the EIS. Other points, such as bonding and certain methods of phased CBM development, were not analyzed in detail for reasons presented in Chapter 2, Alternatives Considered but not Analyzed in Detail.

C-21: BLM should develop and adopt an alternative that provides for the following:

- Effective monitoring of CBM development and active enforcement of existing laws
- Use of aquifer recharge, clustered development, and other best-available technologies to minimize and avoid impacts
- Collection of thorough and up-to-date inventories of fish, wildlife, and plants to ensure they are adequately protected, coupled with the use of phased development so that impacts are diffused
- Complete reclamation of all disturbed areas, which should be ensured by adequate bonds

Furthermore, BLM should provide for meaningful public involvement, including the involvement of private surface owners where the underlying minerals are owned by the federal government, and thoroughly consider and respond to the comments received.

R-21: The bulleted items are address throughout the Alternatives analyzed in the EIS. They will be analyzed in more detail when the agencies review specific project proposals. The private surface owners will be invited and encouraged to participate in the development and review of project plans.

C-22: The agencies should develop an alternative based on the Northern Plains Resource Council's proposal for responsible CBM development, *Doing It Right.* Alternatives should include phasing in development over time, minimized disturbance of wildlife habitat, and surface use agreements.

R-22: See **R-20** and **R-21** above.

C-23: No public hearings were held in Bozeman.

R-23: The MDEQ held a public hearing in Bozeman on April 9, 2002, to address citizen concerns within the area.

C-24: A site-specific EIS should be completed for each area of potential impact.

R-24: During review of specific project proposals, the BLM will use the NEPA screening process and MBOGC will use the MEPA screening process to determine if an EIS is needed to prepare the environmental analysis.

C-25: The size of the EIS precludes most citizens from reading it. It is unrealistic to expect citizens to read such a document, especially when this is only one issue (and one EIS) that affects our lives. I strongly recommend that you produce a small summary document that is widely distributed and make the technical EIS available to those who ask for more information.

R-25: A summary document has been prepared and included with the Final EIS. The summary document is also available separately.

C-26: The DEIS fails to adequately address the fact that several units of the National Park Service are located in the planning area. The DEIS should state specifically that no lands in any National Park Service unit in Montana will be considered in future federal oil and gas development.

R-26: The EIS defines in Chapter 1 the planning area for both the BLM and State and outlines their jurisdictions with respect to administering CBM development activities. Except for cumulative effects, the plan does not cover lands administered by the National Park Service.

C-27: The Lower Brule Sioux Tribe is requesting a 60—day extension to the May 15 deadline for comments on the DEIS.

R-27: The 90-day comment period was not extended.

C-28: The DEIS does not mention increasing energy demands of the United States and the related strategic necessity of a strong domestic energy supply.

R-28: Discussion or analysis of increased energy demands, the need for a strong domestic energy supply, and the relationship to strategic national concerns are not part of the purpose and need for this EIS and are beyond the scope of the document.

C-29: The Northern Cheyenne Reservation comprises approximately 2 percent of the planning area. Does this mean the statewide "Planning Area" or the "Emphasis Area" where the anticipated CBM development will occur?

R-29: The Northern Cheyenne Reservation is not part of the planning area for which the BLM and MBOGC will be making development decisions. See Planning Areas description in Chapter 1. Wells are predicted on the reservation so cumulative effects can be analyzed.

C-30: Your studies need to thoroughly investigate the geographical positions of the mining activities.

R-30: The geographical and contextual locations of the regional coal mines are included in the existing environment description found in Chapter 3. Chapter 4 includes a discussion about potential impacts to the coal mines from CBM activities.

C-31: If BLM's planning area is the Powder River RMP and Billings RMP, the DEIS should disclose the reasons for selectively including information about the Fort Belknap Community Council and Turtle Mountain Public Domain allotments.

R-31: Fort Belknap Community Council and Turtle Mountain Public Domain allotments were included in Chapter 3 in the Indian Trust Assets discussion because of the BLM's trust responsibility and obligation to determine if any impacts would occur on or to these properties from developments predicted in the planning areas.

C-32: Does the term "cooperator" have the same meaning as "cooperating agency"?

R-32: Yes. Cooperating agencies are official participants in the EIS process and have signed a Memorandum of Understanding with the BLM regarding their involvement. Cooperators as used in the context of this EIS is referring to those agencies.

C-33: The discussion of the planning area should identify the Crow and Northern Cheyenne reservations as sovereign planning areas, and the Crow and Northern Cheyenne tribes as sovereign governments with jurisdiction (i.e., authority and responsibility) over their territories.

R-33: The State and the BLM recognize the sovereignty of the Tribes and their reservations as stated in Chapter 1 and Chapter 3 of the Final EIS. The EIS states that the planning area excludes those lands administered by the Crow and Northern Cheyenne and any other Native American lands from the scope of the decisions resulting from this process. The reservations are included in order to assess potential impacts from CBM activities located off of the reservations and to include potential impacts from possible CBM activities on the reservations as part of the cumulative impact analysis.

C-34: Reference is made to the 1994 Oil and Gas Amendment of the Powder River Basin and South Dakota RMPs in Chapter 1. Following this is the BLM 1991 citation, apparently referring to the 1994 Amendment. Is the citation correct? The reference (BLM 1992) falls at the end of this section.

R-34: A 1991 citation in Chapter 1 could not be found. The draft amendment to the original Powder River and Billings RMPs was completed in 1992, while the ROD for these actions was not issued until 1994.

C-35: The Crow Tribe recommends BLM, the MBOGC, MDEQ, and Montana Department of Natural Resources and Conservation (DNRC) include maps displaying ownership of surface and mineral rights.

R-35: Mineral ownership maps are part of the FEIS and RMP amendments issued in 1992 (BLM 1992). Maps are also available at the BLM Miles City Field Office and the Billings State Office.

C-36: Would the Omega alternative be expected to have different production efficiencies or surface impacts than the alternatives studied in detail?

R-36: The Omega alternative was not operational either as a demonstration or a pilot test at the time it was proposed. Therefore, the performance data could not be studied for inclusion in the EIS.

C-37: Why is the BLM's *Big Dry Resource Management Plan/Environmental Impact Statement* cited in this document? The only reference in the DEIS is Chapter 2, Pages 2-3 and 2-6.

R-37: As stated in Chapter 2, the steps BLM requires for obtaining approval to drill and conduct surface operations are summarized in the Big Dry RMP/EIS, Appendix A.

C-38: Obviously, not every well can be drilled at the same time. Therefore, no special effort needs to be made to phase in development. Landowners and mineral owners should have control of the timing and methods of development of their land.

R-38: Many different and sometimes competing factors affect the timing and methods of developing oil and gas resources. The needs of the surface and mineral owners should be given consideration by companies as they prepare plans for lease operations. A mineral owner can include requirements or restrictions on mineral development as terms of the lease. The surface owner can include requirements or restrictions as terms of the Surface Owner's Agreement with the company.

C-39: Because this document purports to be an amendment to the Powder River and Billings RMPs, will notice of this proposed amendment be sent to all the grazing permittees and others who commented on the previously adopted RMPs?

R-39: The mailing list was prepared using permittees, staff mailing lists and local news releases.

C-40: Will CBM operators be required to complete a Toxics Release Inventory Report?

R-40: Toxic Release Inventory reports will not be required from CBM operators. However, all spills of controlled substances are required to be reported immediately to the EPA, State, BLM, FWS, and local authorities.

C-41: The EIS mentions a Water Management Plan. Where can one receive a copy of the plan? Who is going to develop this Water Management Plan and will the public be allowed to comment on it?

R-41: Water Management Plans will be prepared by CBM operators for each project and will include watershed analysis for affected watersheds. The BLM and the MBOGC will review and approve these plans. Affected landowners will be invited to participate in the process.

C-42: Will all of the verbal comments given at the various public hearings and recorded by the court reporter be reproduced in the FEIS?

R-42: Comments received at the public hearings have been incorporated into the Comments and Responses section of Chapter 5 and organized according to resource topic. Copies of the six public hearing transcripts, as well as the MDEQ General Discharge Permit, can be viewed on the BLM and MDEQ CBM web sites.

C-43: Are the BLM and other federal agencies complying with Presidential Executive Order 13212 entitled "Actions to Expedite Energy Related Projects"?

R-43: The review of proposed energy projects within mandated timeframes by federal agencies is a high priority, although other responsibilities and capabilities affect an agency's ability to respond to project proposals. While the referenced Executive Order directs federal agencies to expedite reviews and approvals of proposed energy projects, the Order also instructs agencies to maintain safety, public health and environmental protections.

C-44: There should be a large buffer zone near reservation lands, which clearly wasn't detailed in your document. The document only states that there would be no buffer zone near reservations.

R-44: A buffer zone was considered in Alternatives B and D. The Preferred Alternative (E) does not recommend a buffer zone because land ownership is mostly private. The BLM has developed several mitigation measures to protect tribal assets. See Chapter 2 under the Preferred Alternative and the Northern Cheyenne Mitigation Appendix.

C-45: The BLM should represent our environment and its residents, not narrow self-oriented people and corporations.

R-45: The Federal Land Policy and Management Act of 1976 directs BLM to manage public lands on the basis of multiple use and sustained yield unless otherwise specified by law. While BLM must preserve and protect certain public lands, it is also mandated to manage the public lands recognizing the Nation's need for domestic sources of minerals, food, timber, and fiber. BLM has prepared the EIS with public input, including local, regional and national. Our overall goal is to develop CBM in an environmentally sound manner.

C-46: We are concerned that the DEIS has not given enough consideration to how the proposed development will affect the region's biodiversity.

R-46: The effects on regional biodiversity have been addressed in consultation with the FWS and its conclusions as presented in the Biological Opinion found in the Wildlife Appendix.

C-47: Alternative E leaves too much to industry for deciding an acceptable price to pay for environmental degradation.

R-47: Although industry can propose mitigation measures in their Project Plan and discuss how their proposals may reduce or eliminate impacts, it's ultimately the decision of the BLM and MBOGC to approve these plans and ensure that development actions comply with the given lease stipulations and permit requirements.

C-48: The EIS is incomplete because it does not include numeric standards.

R-48: The MDEQ has specific requirements for developing numeric standards that are not done in an EIS. The MDEQ is currently developing total maximum daily loads (TMDLs) of surface waters in Montana for numerous constituents. These numerical standards will affect how the MDEQ issues discharge permits for various industries, including the oil and gas industry.

C-49: The authors of this document have underestimated the amount of surface that actually will be damaged.

R-49: The analysis includes potential direct and indirect as well as short-term and long-term impacts to other resources, including surface disturbance, from CBM activities. The potential amount of surface disturbance is based on acres disturbed by typical existing CBM activities.

C-50: A single EIS for all of Montana is a mistake. The proposed drilling areas are very different and each environment should be studied separately.

R-50: The EIS analyzes typical CBM operations in certain geographical, biologic, cultural, and economic environments. Additional environmental analyses will be conducted for specific project proposals. See responses to similar comments ***C-3*** and ***C-23***.

C-51: BLM should allow ample time for public comment.

R-51: BLM followed the CEQ requirements for a 90-day public comment period.

C-52: The Preferred Alternative should adopt the road/utility corridor provisions of Alternative B.

R-52: Although the Preferred Alternative would not require the use of corridors, operators would be encouraged to locate multiple flowlines in the same trench along the access road whenever possible. The Preferred Alternative allows the flexibility to locate flowlines and power lines as needed after evaluating many factors, including the needs of private surface owners. The operator will address in the Project Plan how the surface owner was consulted for input into the location of roads, pipelines, and utility line routes.

C-53: The experience of other areas should be carefully scrutinized and used to guide the development of alternatives. The CX Ranch studies, Wyoming's experience, and Colorado's experience should be factored into the analysis.

R-53: Other applicable studies pertaining to regional CBM development were reviewed and incorporated by specialists into their respective resource topic impact discussions. See the Bibliography for a list of references.

C-54: The BLM and the State should focus this DEIS on the Lower Tongue and Powder River basins, as it appears to be the focal point of future CBM development.

R-54: The CBM emphasis area encompassed the Lower Tongue and Powder River basins as the focus of the study.

C-55: A direct assessment of Alternative E with releases of CBM water to surface water is likely to exceed proposed water quality standards for several rivers of the basin. Therefore, this alternative may not be acceptable with respect to water quality.

R-55: A direct assessment of assumed water discharges that would occur under Alternative E has been conducted in the FEIS Hydrological Resources section of Chapter 4. The analysis indicates that surface water quality will be slightly altered, but State and Northern Cheyenne water quality standards would be met and existing beneficial uses would be protected.

C-56: If the Preferred Alternative is followed, the following should be included in the alternative:

- Consultation with fish and wildlife management agencies and other affected parties, as well as consultation with surface owners
- Commitment to conducting a permit/project site
- Other surface facilities (i.e., roads, compressor stations, impoundments, etc.) in the operators' demonstration of how their proposals would mitigate impacts on wildlife and fish
- A project-specific explanation and mitigation plan for impacts on neighboring activities and resources (fish, wildlife, agriculture, recreation, coal mining, etc.) or potentials for resource development

R-56: All of these issues have been incorporated into the Preferred Alternative as mitigation measures, the Wildlife Monitoring and Protection Plan, or will be addressed in the project Plan of Development.

C-57: The DEIS is inadequate in its analysis of the fire risks posed for Bozeman Pass area residents.

R-57: When and if an operator proposes to develop the Bozeman Pass area, an EA or EIS would be required that addresses site-specific concerns such as fire risk.

C-58: The DEIS seems to divide ecosystems into pieces, thereby dividing one watershed between separate analyses, so it can avoid full disclosure of cumulative impacts and the need to minimize them.

R-58: The FEIS impact analysis conducted for resource topics includes a full range of potential projects that might add to the cumulative effect. A full explanation of cumulative impacts within the level of planning for these actions has been disclosed in Chapter 4.

C-59: A longer development cycle, perhaps 40 years instead of 20, could bring more economic benefit to the region.

R-59: The length of the development cycle is dependent upon economics of the product (gas), and the producing company's strategies. BLM has a legal obligation to ensure that leased federal minerals are reasonably developed and that federal minerals are not drained by production that occurs on non-federal leases. The State and private parties own much of the minerals and surface in the emphasis area, resulting in a checkerboard pattern that could compromise the BLM's legal obligation to protect federal minerals.

C-60: The state and federal government should hold off on development until all studies necessary for the analysis are completed.

R-60: The quantity of information that has been obtained to date is sufficient to support the development of CBM under the provisions of Alternative E—Preferred Alternative. Additional site-specific information would be obtained for further evaluation as CBM projects are proposed.

C-61: For clarity, spell out "Montana Environmental Policy Act (MEPA).

R-61: The acronym MEPA is included in and spelled out in the Acronym List in the FEIS.

C-62: BLM and the State should use the operating standards and mitigation measures presented in the Draft EIS and Draft Planning Amendment for the Powder River Basin Oil and Gas Projection. The Buffalo Field Office has developed successful standards and measures from past experience that can be transferred to Montana oil and gas operations.

R-62: These measures were considered in preparation of the FEIS. The State also has its own laws and regulations that need to be considered during the development of management alternatives.

C-63: The BLM DEIS fails to recognize and address impacts from ongoing CBM development in other areas.

R-63: Both the DEIS and FEIS included existing CBM development in the State to develop the impact analyses for each alternative. CBM development in Wyoming was included as part of the cumulative effects analysis.

C-64: The requirement of surface owner consultation prior to approvals will help protect private property rights.

R-64: Both BLM and the State strongly encourage company representatives to enter into discussions with private surface owners and mineral owners as early as possible and to continue discussions during the life of the project. Agencies will consider the concerns and requirements of private surface owners, and incorporate mitigation requirements with approved permits as allowed by law and regulation. Alternative E, the preferred alternative, includes language addressing this point.

C-65: The producer should pay for all inspection costs.

R-65: The BLM and State bear the responsibility for conducting inspections associated with activities they have approved. The inspections are intended to determine compliance with approved permits and regulations, the effectiveness of mitigation measures, and the need to modify mitigation measures. Inspections may be conducted solely by agency personnel or with company representatives or surface owners.

C-66: The massive scale and rapid time frame for CBM development is wrong. Development should be slow and small to allow for developing good plans and creating additional technology to mitigate impacts.

R-66: Many factors influence the location, scale, and speed of CBM development. The needs of mineral owners, surface owners, lease holders, and land management agencies also affect CBM development. Adaptive management practices would be employed by CBM companies as a result of monitoring data and technology improvements.

Air Quality and Climate

Comments and Responses

Comment 1 (C-1): Livestock can be seriously impacted by blowing dust from roads and development. Historically, cattle have died from severe exposure. Has this been evaluated, and, if there are impacts, who would pay for it?

Response 1 (R-1): Fugitive dust emissions from access roads and other CBM activities have been addressed in the EIS. Air pollution permits issued for CBM development activities will require use of dust control measures (e.g., water, speed limits, etc.) ensure compliance with state regulations. A study on the potential impacts of small dust particles (PM_{10} and $PM_{2.5}$) on regional air quality (versus federal air quality standards) has been performed and the results included in the FEIS. The issue of compensation for damage and losses is outside the scope of this document. However, reporting of purported air quality violations and nuisance dust problems is addressed in ***R-2***, below.

C-2: Problems from excessive dust caused by roads and traffic will be severe. How will air quality violations be monitored and what will happen if the standards are exceeded?

R-2: Visible dust emissions will be controlled by the operating companies and monitored by both the operating companies and regulating agency personnel. The control and monitoring will be performed in accordance with the terms of air permits issued for the developments, on which the public will have the opportunity to provide comments. Companies would be required to implement changes in operations to be in compliance with permits if standards are exceeded. Suspected violations of the terms of these permits may be reported to the appropriate regulating agency, in most cases the MDEQ.

C-3: In Chapter 4, Air Quality and Climate, increased traffic through the reservation because of increased population and development will have an effect on the air quality.

R-3: Potential impacts on air quality on the Northern Cheyenne Reservation, as well as other areas in the region, have been evaluated using complex modeling programs. The air quality was assessed using existing background concentrations and the impacts from reasonable foreseeable development and alternative scenarios. The effects on air quality are addressed in Chapter 4.

C-4: The study assumes one trip per week per well site will be required to refill the fuel tanks for either propane or diesel. Since diesel has a heating value approximately 1.5 times greater than propane, in a three-month period four fewer trips per well site would actually be made for diesel fired engines. This would mean much less dust contributing to PM_{10} levels. This should be considered in the air quality analysis. The analysis should also provide for an economic analysis that compares the difference in cost of diesel fuel vs. propane.

R-4: The number of vehicle trips may be lower for different fuels. However, the number of vehicle trips per fuel type was not considered in this evaluation due to the unlimited number of situations and variables involved (e.g., distance to fueling stations, operating efficiencies, etc.). The companies developing CBM facilities are expected to perform the technical and economic evaluations given the specific characteristics of their developments, as well as the fuels and equipment available. Therefore, to simplify the analysis one vehicle trip per week per well site was assumed. It should also be noted that other operation and maintenance activities may be associated with this weekly trip.

C-5: Will any dust attenuation measures be taken? If so, what are they and what impacts might they have? What will be used for dust suppression and what are nonsaline dust suppressants? What will their impacts be on the environment? If water is to be used, what will be the source? What mitigation measures would be used to control dust?

R-5: Application of water is the most common form of controlling dust emissions; however, numerous other surfactants, dust suppressant oils, etc. may be used. Examples of alternative dust suppressants are given in: http://www.deq.state.mt.us/pcd/awm/forms/haz_dust_suppres_altern.doc. The Air Quality Modeling Appendix also includes fugitive dust mitigation measures, relative effectiveness of such measures and costs. The methods will be specified in the air permits issued for the project developments. The public will have the opportunity to provide comments on these projects.

C-6: What rights do landowners have for recourse when they experience noise and air pollution on their ranches?

R-6: See ***R-1*** and ***R-2.*** Citizens who feel they have experienced undue air quality and noise impacts should first contact the appropriate government agency to investigate and provide relief (such as their local municipality, county, state, federal or tribal agencies). For illegal air quality impacts, private citizen's suits are permitted under CAA Section 304.

C-7: The air quality data on existing conditions are seriously deficient and the air pollution assessment does not provide a meaningful examine of potential air quality impacts.

R-7: A comprehensive air quality analysis has been performed. The air quality analysis used existing background concentrations and the impacts from reasonably foreseeable development and alternative scenarios. The air quality modeling findings represent the general potential impact on Class I (e.g., wilderness areas) and Class II areas in the region. Air permits will be required for the proposed development plans. The air permit applications will need to include demonstrations that the CBM operations will not violate the National Ambient Air Quality Standards (NAAQS) and Montana Ambient Air Quality Standards (MAAQS) in the area. This analysis would take into account local air quality issues. The MDEQ may be contacted for more information on public and private air monitoring stations in the region. Additionally, a single, combined Technical Support Document - Air Quality Impact Assessment (Argonne 2002) was prepared, including several revisions suggested in public comments on the DEIS, to support publication of both states' FEIS' (i.e., this EIS and the Wyoming BLM's Final Environmental Impact Statement and Draft Planning Amendment for the Powder River Basin Oil and Gas Project).

C-8: Where are the monitors used for baseline monitoring? Why is the air quality data collected on the reservation (Table 3-1) not presented as baseline data?

R-8: The background data was taken from various monitoring stations, including urban areas, in the State and therefore considered representative for the region as a whole. Given that this may yield relatively higher values relative to solely high air quality rural areas, it appropriately represents areas where impacts have already occurred and additional impacts are more critical from a NAAQS and MAAQS standpoint. The tribally designated Northern Cheyenne Reservation Class I (high air quality) area is subject to special protection to limit degradation of air quality and has more restrictive limits on the amount of degradation allowed. The air quality modeling assesses the potential impact on both Class I and Class II areas and is included in the final EIS.

C-9: The air monitoring plans are inadequate in frequency and in number and placement of monitoring stations.

R-9: As a part of the application approval, MDEQ determines the number, placement and reporting requirements for monitoring stations associated with the permit. MDEQ operates monitoring stations throughout the state. Proposed monitoring plans for a specific area can be submitted to the MDEQ for consideration during the permitting process.

C-10: What will the cumulative impacts of air quality be from CBM development in Wyoming?

R-10: The air quality modeling results include analysis of potential cumulative impacts from emission sources in Montana, Wyoming, North Dakota, South Dakota, and Nebraska, as well as Wyoming Powder River Basin Oil and Gas Projects. The results of the modeling indicate that operators of existing and proposed emission sources will have to implement mitigation measures to ensure compliance with air quality standards.

C-11: The EIS doesn't consider these air quality impacts: 1) release of sulfides that contribute to acid precipitation, and 2) the impacts of global climate change from emissions of methane-migration and venting (intentional and unintentional) and other emissions.

R-11: The potential impacts of pollutants associated with acid deposition (rain) are addressed through air quality modeling. The modeling analysis for atmospheric depositions is presented in the final EIS and detailed in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002). Controlled and uncontrolled venting of methane and other pollutants will be addressed in the state and/or federal air quality permits. See **R-88** regarding climate change.

C-12: Chapter 2 mentions noise from gas-fired engines at compressor stations. What are the penalties if the 50-decibel level is exceeded?

R-12: Appropriate noise mitigation is required to reduce the decibel level to required limits. If exceeded, additional engineering controls would be installed.

C-13: In Chapter 4, Assumptions Common to All Alternatives, the EIS should advise the reader that generators are subject to air quality permitting rules and regulations administered by the MDEQ.

R-13: Generators, as well as compressors, are subject to the air quality and permitting rules and regulations administered by the MDEQ. Note that this issue is identified in Resource Topics, Air Quality and Climate.

C-14: In Chapter 4, Air Quality and Climate, we understand that air quality in Wyoming is reaching limits that will trigger limits on further coal mining and CBM development. What can be done differently in Montana to prevent this situation?

R-14: Existing air quality regulations limit the degradation of air quality in the region. Development of CBM as well as other pollutant sources may be limited as a result of these regulations or operators of emission sources would be required to implement mitigation measures to ensure compliance with standards. The regulations function on a first come, first served basis, so future developments may need to incorporate plans to reduce existing emission sources.

C-15: In Chapter 4, Air Quality and Climate, a more detailed explanation of Best Available Control Technology (BACT) analysis and determination would be appropriate in this section.

R-15: The BACT analysis is a process whereby a company must demonstrate that the BACT will be used to control pollutants from the source. The analysis is based on technology, economics and other issues. The BACT analysis process is fairly complex. Specific descriptions of the BACT analysis will be included in applicable permit applications submitted to the MDEQ. The MDEQ and Region VIII EPA offices may be contacted for additional information.

C-16: In Chapter 4, Air Quality and Climate, was air quality analyzed as one well at a time or as a fully developed field? Will this trigger an EA under Montana air permit requirements?

R-16: The potential impacts on regional air quality assumes full field development, as well as reasonable foreseeable development activities. MDEQ will conduct an environmental analysis as part of the air permit application process. Also, refer to ***R-7*** and ***R-10***.

C-17: In Chapter 4, Impacts From Management Specific to Each Alternative the assumption that potential 8-hour hazardous air pollutant concentrations would be below a range of maximum Acceptable Ambient Concentration Levels identified in other states should be clarified.

R-17: The State of Montana currently does not have specific air toxic regulations. In order to assess potential impacts caused by air toxins from CBM operations, emissions are compared against air toxic standards set in other States.

C-18: In Chapter 4 under Air Quality in the Impacts From Management Specific to Each Alternative section, it states that mitigation, monitoring, testing, inventorying, and reporting may be required as part of any air quality permitting. The reader should be apprised of these additional mitigation measures that the respective agency has the authority to request.

R-18: The public may obtain information and provide comments on proposed air permits regarding monitoring, testing, inventorying and reporting. Refer to ***R-2***, ***R-5***, and ***R-9***. The Air Quality Modeling Appendix in the FEIS includes more detailed information about mitigation measures, agency authorities and permitting processes.

C-19: BLM must complete a thorough review of the Wyoming and Montana State Implementation Plans (SIP) and assess how the project will conform to SIP provisions aimed at achieving the NAAQS for particulate matter in Sheridan and Rosebud counties.

R-19: BLM's responsibility to perform a site-specific Conformity Analysis (and possible Determination), demonstrating the proposed activity will comply with all applicable air quality requirements of a SIP, before these activities can take place in non-attainment or maintenance areas, has been documented in the FEIS. However, under EPA's General Conformity Regulations the analysis is to be performed "before the action is taken," not necessarily at the programmatic NEPA analysis stage. The Conformity Analysis may either be tiered to a NEPA analysis, or prepared separately. For those activities that BLM may conduct within designated nonattainment or maintenance areas including the Lame Deer Moderate PM_{10}, Billings CO, Laurel Area SO_2, or Sheridan (WY) Moderate PM_{10} nonattainment areas, a site-specific Conformity Analysis (and possible Determination) will be conducted before the specific action is taken.

C-20: What are the impacts from generators?

R-20: Air quality impacts from generators, as well as from compressors, road dust, etc., are included in the FEIS, Chapter 4.

C-21: Is Billings a non-attainment area for carbon monoxide (CO)?

R-21: Billings is a "maintenance area" for CO; it was formerly designated a non-attainment area.

C-22: We need an analysis of the impacts of CBM development on air quality. Can you describe the impacts caused by the increased traffic and carbon dioxide (CO_2) generation? Will there be an increased chance of wildfires and what will be the impacts of fires on air quality?

R-22: Potential impacts on air quality in the region, including the reservations, have been determined based on modeling. Cumulative impacts from increased traffic and other types of developments were also included in the air quality analysis. An increase in the number of wildfires could occur as a result of increased human activities associated with CBM development; however, wildfires were not included because they are not readily predictable,.

C-23: We've heard that hydrogen sulfide is a dangerous pollutant and is released from CBM wells. How will we be protected?

R-23: Current data does not show that H_2S is produced by CBM wells in the Montana portion of the Powder River Basin. The State of Montana and Bureau of Land Management have regulations specific for hydrogen sulfide (H_2S) emissions from oil and gas development. Developers of federal minerals will need to show compliance with Onshore Oil and Gas Order No. 6, which requires special precautions to protect workers essential to well control and the public.

C-24: The EIS does not mention the benefit of capturing methane gas and not allowing it escape into the atmosphere. Can you explain?

R-24: A general statement regarding this issue was added to the FEIS, Chapter 4.

C-25: Comments on the DEIS recommended specific text changes.

R-25: These changes were either made as recommended, or were no longer applicable due to the revised combined Montana and Wyoming FEIS air quality impact analysis.

C-26: The DEIS does not ensure the Proposed Action or Alternatives will comply with federal and state air pollution standards, including the requirements of the PSD program. Under FLPMA Section 202, BLM cannot defer this compliance to a "project" level analysis. Furthermore, without quantifying potential impacts, even if comparisons of alternative management practices are meant to assure us that potential impacts won't be as bad as the "no enforcement - full development" case, informed choices among alternatives can not be made.

R-26: Both the DEIS and FEIS clearly disclose that "FLPMA (43 U.S.C 1701 et seq.) and the CAA (42 U.S.C 7401 et seq.) as amended, require that BLM assure the actions it conducts or authorizes (including oil and gas development) comply with all applicable local, state, tribal and federal air quality laws, regulations, standards, and implementation plans. Local, state and tribal requirements may be more (but not less) stringent than federal requirements." BLM has not attempted to "defer this compliance to a 'project' level analysis," however, site-specific analysis of potential air quality impacts is simply beyond the scope of this analysis and compliance cannot be assured until a project level analysis is performed. Also see R-7. The FEIS air quality analysis is not intended to represent a formal regulatory PSD analysis of proposed projects, rather it presents potential impacts from proposed development alternatives. The regulatory agencies in each State have responsibility for requiring a formal regulatory PSD analysis for both PRBO&G and non-PRBO&G proposed projects. Specific mitigation, monitoring and other requirements will be specified at that time based on existing, actual data. Additional text has been added to the FEIS to try and clarify this issue.

C-27: The Bozeman Pass residential area, with an elementary school, is located within the CBM emphasis area. The DEIS fails to adequately address air quality impacts across the state, let alone in the Bozeman Pass area where housing is in close proximity to potential industrial development.

R-27: The FEIS includes a description of potential impacts to air quality. Gallatin and Park Counties were included in the detailed modeling conducting to assess potential impacts. Further analysis of site-specific surface disturbing activity will be required before construction can occur. For example, an APD includes several environmental protection provisions, including the mandatory compliance with all applicable air quality regulations. Site-specific analysis of potential air quality impacts is simply beyond the scope of the FEIS, and compliance cannot be assured until a project level analysis is performed

C-28: Based on experiences in Wyoming, we are concerned that measures to limit air quality impacts will be insufficient, triggering limits on further coal mining and CBM development in Montana. How will we be protected from health and economic degradation that will come from dust and other air quality impacts? What will happen if air quality standards are exceeded? How will air quality violations be monitored?

R-28: **See R-6**. Since the CAA was originally passed in 1955, the U.S. Congress has delegated implementation of the Act to applicable local, state and tribal air quality regulatory agencies, with EPA oversight since 1970. These agencies have the responsibility and authority to protect the public from "health and economic degradation that [may] come from dust and other air quality impacts," and each agency has its own procedures for preventing, monitoring, investigating and enforcing potential air quality violations (including the exceedance of applicable air quality standards).

C-29: The rapid expansion of CBM exploration and development emphasizes the need for early coordination between BLM and the NPS prior to approval of specific lease tracts which may adversely affect park NPS units.

R-29: BLM will continue to work closely with agencies and members of the public who may be affected by BLM decisions. Interested groups are encouraged to contact either the Miles City or Billings Field Offices specifically regarding future CBM exploration and development activities.

C-30: The DEIS addressing potential CBM development in Montana, and a DEIS for similar development in Wyoming, should have used a single cumulative air quality impact assessment.

R-30: This has been done in the air quality impact analysis for the Montana Statewide Oil and Gas FEIS and is detailed in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002). This quantitative air quality impact assessment analyzes potential oil and gas activities, as well as other non-project activities, throughout southeastern Montana, northeastern Wyoming, S. Dakota, N. Dakota and Nebraska. The combined analysis was prepared to support publication of both states' FEIS'

C-31: The DEIS failed to address air pollutant emission sources (including sources of particulate matter, nitrogen oxides, SO_2 and other hazardous pollutants) resulting from the same extraction methods in Wyoming. Consequently, "the best way to adequately assess the combined impacts of similar actions or reasonable alternatives to such actions is to treat them in a single impact statement." Air pollutant emissions from the entire area should be evaluated as a whole.

R-31: As described above, "air pollutant emissions from the entire area" of southeastern Montana and northeastern Wyoming were combined for the analysis of impacts in the FEIS. A single Technical Support Document - Air Quality Impact Assessment (Argonne 2002) was prepared to support publication of both states' FEIS'.

C-32: Because separate DEIS' were prepared in Montana and Wyoming, various alternatives were considered then dropped for various reasons, with differing outcomes and associated impacts. For example, the Wyoming DEIS alternatives focused exclusively on water issues, ignoring a myriad of potential air quality impacts. These potential impacts are integral to the project, and should have been included in developing both the management alternatives and mitigation strategies.

R-32: Both documents describe the process by which Alternatives were "Analyzed in Detail," or were "Considered but Not Analyzed in Detail." Potential air quality impacts were clearly identified as issues in both documents and both documents did consider an Alternative in detail that would limit emission sources and air quality impacts. **See R-30.**

C-33: Rather than limiting the DEIS alternatives to use of natural gas for the reciprocating compressors and varying amounts of electricity to power the booster compressors, a more distinct set of alternatives should be identified, such as partial development, with continuing evaluation studies, spread out over a longer time period, allows options to introduce new control technologies and/or to propose stricter guidelines.

R-33: **See R-32.** Additionally, other alternatives that are not included in the detailed analysis such as partial/phased development are discussed in Chapter 2 of the FEIS (including the reasoning for why they were eliminated from detailed analyses). Furthermore, the actual application of control technologies and the ability to propose stricter guidelines will be evaluated at permitting stages of development and be equipment specific.

C-34: The DEIS and the Air Quality Impact Assessment seem to address different "no build" situations under the "No Action" alternative. This inconsistency might be a serious flaw, misleading the public, tribal leaders and decision makers.

R-34: The No Action Alternative is a description of the current management of CBM by BLM and the State. The FEIS describes the potential impacts from projected CBM operations and cumulative impacts from other activities in addition to projected CBM operations.

C-35: The DEIS statement "Since the direct Alternative C and cumulative air pollutant emission sources constitute many minor sources spread out over a very large area, it is unlikely the maximum potential air quality impacts [would exceed applicable threshold levels]" was based solely on anticipated emission levels. A quantitative analysis of potential air quality impacts using an appropriate quantitative air quality impact model is necessary to make this assertion, and essential for providing full disclosure of potential impacts under NEPA.

R-35: The quantitative analysis is presented in the FEIS, based on the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002). **See also R-7**.

C-36: Because the Montana air quality impact analysis was not available before this DEIS' comment period closed, additional air quality impact analyses should be included in a revised or supplemental Draft EIS, in order to provide the public an adequate opportunity to review and comment on this complex issue.

R-36: A qualitative air quality impact assessment was prepared for and published in the Final EIS. Although specific potential air quality impact values have changed in the Final EIS, the basic conclusions of the Draft EIS remain the same. That is, direct air quality impacts from CBM activities are not likely to exceed Ambient Air Quality or PSD Standards under any Alternative. However, there is a potential for cumulative air quality impacts to exceed short-term PSD Class I and II increments, as well as ambient air quality standards, applicable visibility and ANC thresholds under various proposed Alternatives.

BLM carefully considered whether to issue a supplement to the DEIS before publishing the Final EIS. The action depicted in the Final EIS has not changed substantially from the Draft EIS. New information has been considered in response to comments received on the DEIS. The analysis used in the FEIS to predict air impacts was improved and some of the analytical assumptions were changed based on the most current information, and in response to comments. The models used in the FEIS do predict that exceedances of some standards could occur for some pollutants. However, the mitigation measures that have been developed will be implemented to prevent some of the predicted impacts from occurring.

The FEIS describes how the agencies will take action by requiring additional analysis and conducting monitoring to ensure that any mitigation measures required as conditions of approval on permits will be effective to ensure compliance with all applicable standards. BLM and the other cooperating agencies will implement adaptive management strategies as needed to prevent potential violations of environmental standards predicted in the models and to facilitate the goals for improvement of air quality.

The new information doesn't meet the regulatory standard for significance because the impacts predicted will be mitigated to a level not significantly different from those predicted in the DEIS, and certainly to a level that will ensure compliance with environmental standards for water and air. The need to mitigate impacts and prevent regulatory violations was assumed in the DEIS as well; and BLM's commitment to implementing such measures as may be needed is clarified in the FEIS. The potential impacts disclosed in the FEIS help identify and predict the nature of pollutants that will need to be mitigated when future permitting activities are considered by both the BLM and State. The FEIS acknowledges that, as part of the process for consideration of permit applications, the water and air quality regulatory agencies would conduct monitoring and require mitigation measures as needed to ensure compliance with all applicable standards before permits would be approved. All potential exceedances of the established water and air quality standards would be prevented in this manner, and the other changes in impacts overall are not significantly different than the impacts described in the DEIS. Therefore, we conclude that the changes between the DEIS and the FEIS do not meet the regulatory standards for substantial changes in the proposed action, or because of significant new information or circumstances relevant to environmental concerns and bearing on the proposed action or it's impacts; and do not require a supplement to the DEIS to be circulated.

C-37: The DEIS does not: present any current ambient air quality or visibility monitoring data; present any specific or cumulative emissions data for any proposed or reasonably foreseeable sources; present any specific or cumulative air quality/visibility impact analyses for any proposed or reasonably foreseeable sources; allow for any timely critical review of such data and analyses.

The DEIS inappropriately depends on future piece-meal source specific air quality permitting requirements to determine potential air quality impacts, in lieu of specific analyses of the expected number of such facilities and their respective air pollutant emissions. Will future analyses be conducted for a fully developed gas field, or one well at a time? Will site-specific NEPA analyses be required by Montana air pollutant emission permitting?

R-37: The qualitative analysis presented in the DEIS has been revised with a quantitative analysis presented in the FEIS, based on the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002). The FEIS is required under NEPA to discloses the potential "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions". Detailed site-specific analyses will be done by BLM for CBM exploration and development proposals. Additionally, the Montana DEQ will perform a detailed air quality analysis of actual proposed facilities (e.g., compressor stations) as part of the air permit application process. **See also R-7**.

C-38: Given the lack of a quantified air quality impact analysis, the DEIS statement "based on the 'reasonable, but conservative' assumptions, direct and cumulative impacts are assumed to be within applicable air quality standards" is unsubstantiated. While the DEIS does indicate an air quality dispersion analysis is underway, and will be available for the Final EIS, this quantified analysis should have been included in the DEIS. In addition, the DEIS statement "Impacts to air quality would be localized and short-term in duration, lasting from hours to days" does not take into account that such events can often be severe or frequent.

R-38: **See R-7 and R-37**. The qualitative analysis presented in the DEIS has been revised with a quantitative analysis presented in the FEIS, based on the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002). The revised cumulative air quality impact assessment included a quantitative analysis of conditions which could be "severe or frequent," and disclosed the potential for cumulative air quality impacts under all Alternatives.

C-39: The DEIS and the Air Quality Impact Assessment refer to background documents without specifically summarizing what each source contributed. Since these documents were unavailable for review, the relevant assumptions can not be evaluated.

R-39: The Bibliography and References sections of FEIS and the Technical Support Document - Air Quality Impact Assessment (Argonne 2002) have been revised. Details on source contribution are given in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-40: The DEIS failed to include all new air pollutant emission sources in the air quality impact assessment. This action contravenes NEPA, which requires review of all "past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."

R-40: The detailed quantitative technical analysis conducted for the FEIS included an evaluation of reasonable foreseeable future actions (RFFA) as well as existing and permitted emission sources within the modeling domain of Montana, Wyoming, S. Dakota, N. Dakota and Nebraska. To the extent that existing monitoring data (as disclosed in the Affected Environment section) present air quality impacts from past projects, they do not require separate analysis. Similarly, where applicable, the air quality impact assessment should analyze and report potential direct impacts from the Proposed Action and Alternatives (as disclosed in the Environment Consequences section). The direct impact analysis may optionally examine potential impacts from each Alternative, or where no "significant adverse" impacts are anticipated, simply analyze the single Alternative with the greatest potential air quality impacts, and describe all other Alternatives as "likely to have lower potential air quality impacts." However, in order to conduct a cumulative air quality impact analysis, other RFFA sources must be analyzed and combined with both the past sources (Affected Environment) and direct impacts (Proposed Action and Alternatives). RFFAs are those potential future activities which have not yet occurred, but based on informed professional judgement, are likely to have a combined air quality impact with the Proposed Action or Alternatives. This may include reasonably foreseeable modifications to past sources, or altogether new sources. By no means are all potential future activities to be automatically considered as RFFA sources. The determination must consider the past actions and the likelihood a specific activity will be developed and operate within the same time frame and spatial extent of the Proposed Action or Alternatives so as to cause a cumulative air quality impact. Details on the emission sources included in the study are given in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-41: The DEIS failed to include several major emission sources as potential RFD actions, therefore the cumulative air quality impact analysis is lacking these important new sources, each of which has the potential to cause an adverse impact.

R-41: **See R 40.**

C-42: The DEIS failed to consider the health effects and environmental impacts to populations exposed to air pollution generated from burning the fuels outside the analysis domain which would be produced under the Proposed Action and Alternatives, including the economic consequences of reduced life expectancy, increased medical cost, and restricted activity days that would result. An honest and open public debate about our nation's energy policy should include public health concerns on an equal footing as security and economic considerations.

R-42: The DEIS and FEIS analyzed and disclosed potential air quality impacts from the Proposed Action and all reasonable Alternatives (including "No Action"), but an analysis of "the health effects and environmental impacts to populations exposed to air pollution generated from" potential natural gas development, "including the economic consequences of reduced life expectancy, increased medical cost and restricted activity days that would result" is beyond the scope of the analysis.

C-43: The DEIS fails to describe potential air quality impacts that would occur by a significant augmentation (up to 3.6 billion cubic feet per day) of the national gas supply, including potential fuel substitution at locations remote from the project site. Were the socioeconomic multiplier effects on air quality considered? If natural gas is not available from the Powder River Basin, will power plants continue to burn coal?

R-43: **See R-42.**

C-44: The DEIS did not examine potential adverse cumulative air quality impacts on human health and the environment. What cumulative air quality impacts are likely to occur?

R-44: The qualitative analysis presented in the DEIS has been revised with a quantitative analysis presented in the FEIS, based on the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002) The quantitative analysis describes potential impacts on human health and the environment. A near-field analysis of hazardous air pollutants is provided in the Alternative discussions (Chapter 4) as well as the in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002). Impacts on the environment such as deposition and visibility have also been included in the FEIS.

C-45: The DEIS failed to provide adequate air quality information needed to compare potential impacts from the Proposed Action and Alternatives on the existing environment. Were all monitoring data considered? Where are air quality monitors located? Why were air quality status maps excluded? How about maps of existing and potential air pollutant emission sources? Detailed emissions inventories? PSD baseline values? The air monitoring plans in the appendix are inadequate - twice a year isn't enough.

R-45: The qualitative analysis presented in the DEIS has been revised with a quantitative analysis presented in the FEIS, based on the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002). The revised cumulative air impact assessment disclosed the potential for cumulative air quality impacts under all Alternatives. Specific air quality-related information (including: monitoring locations; nonattainment and PSD Class I status; Proposed Action, Alternative, and RFD emission source locations; detailed emissions inventories; prevailing and modeled winds; etc.) were assembled, reviewed, and analyzed for the FEIS, and detailed in the Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

As part of the analysis, monitoring data obtained throughout northeastern Wyoming and southeastern Montana were assembled and reviewed, and although the monitoring data were collected primarily in urban or industrial areas, the data were considered to be the best available representation of background air pollutant concentrations throughout the CBM emphasis area. The PSD increment comparisons prepared for the NEPA documents do not represent a regulatory PSD Increment Consumption Analysis, but an assessment intended to evaluate a threshold of concern for potential impacts. Regulatory PSD baseline values were not utilized.

C-46: The DEIS states "Although site-specific quality monitoring is not conducted throughout most of the CBM emphasis area, air quality conditions are likely to be very good." Shouldn't ambient air quality data be collected now, rather than after development begins? Does the DEIS intend to suggest that because the region currently has clean air, there is a large capacity for additional air pollution?

R-46: Existing monitoring data were assembled, reviewed, and reported in the FEIS. Although these data were collected primarily in urban or industrial areas, they represent background air pollutant concentrations throughout the CBM emphasis area. This evaluation was performed to describe the Affected Environment as required by CEQ regulations (40 CFR 1502.15). Neither the DEIS or FEIS suggested "that because the region currently has clean air, there is a large capacity for additional air pollution." In fact, the capacity for air quality degradation was specifically analyzed and reported in the FEIS. Details are provided in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-47: The DEIS states "Although monitoring is primarily conducted in urban or industrial areas, the data are considered to be the best available representation of background air pollutant concentrations through out the CBM emphasis area." Failure to collect necessary baseline air quality data is contrary to the NEPA requirement to do so when faced with incomplete or unavailable information.

R-47: The Montana Department of Environmental Quality provided background air pollutant concentrations for the analysis area. The available air quality data was determined to be adequate for these purposes. Additional monitoring data collected by the Northern Cheyenne Tribe is included in the Air Quality Modeling Appendix. **See R-45, R-46, R-48 and R-49**.

C-48: The DEIS used CO data collected in Billings, and NO_2 data collected in Rosebud County, to represent the existing air quality conditions throughout the CBM emphasis area. Isn't Billings a nonattainment area for CO? Colstrip (in Rosebud County) is home to four power plants and two coal mines.

R-48: It was determined through meetings with the regulatory agencies that the air quality monitoring data representative of the CBM emphasis area were utilized in the FEIS, and detailed in the Technical Support Document - Air Quality Impact Assessment (Argonne 2002). **See R-46, and R-47**.

C-49: Why didn't the DEIS reference $PM_{2.5}$ and PM_{10} data collected in Lame Deer, Montana, when describing the background air quality conditions? Since Lame Deer, Montana is a moderate PM_{10} nonattainment area, what air quality data did the DEIS use to determine there will not be any adverse $PM_{2.5}$ and PM_{10} impacts?

R-49: In both the DEIS and FEIS, Lame Deer, Montana is described as a moderate PM_{10} nonattainment area, and potential impacts to Lame Deer local air quality is addressed. The Lame Deer $PM_{2.5}$ and PM_{10} data are not representative of the CBM emphasis area in general, and were not included when describing the assumed background air quality conditions.

C-50: BLM has failed to comply with its legal responsibilities under the CAA's general conformity requirements by failing to examine potential air quality impacts on the following nonattainment areas: the City of Sheridan, Wyoming; part of Rosebud County, Montana; and part of Yellowstone County, Montana. Therefore, the BLM must complete a thorough review of the Wyoming and Montana SIPs and assess how its actions will conform to SIP provisions aimed at achieving the NAAQS. BLM cannot simply defer its responsibility to future actions by another agency.

R-50: **See R-19**.

C-51: The DEIS does not adequately describe existing air quality trends in the Powder River Basin: air quality conditions have changed considerably during the last several years. Beginning in 1999, PM_{10} impacts from unpaved roads have been measured at or above the Class II PSD increment, culminating in 13 exceedances of the NAAQS in 2001 and 2002. Since the DEIS did not disclose this situation, and with the potential increase in road use, the cumulative analysis should be revised to include these data , revise its predictions, and mitigation measures should be analyzed (in consultation with the Wyoming DEQ).

R-51: A review of data collected at monitoring locations in Wyoming (EPA 2002b and Payton 2002) indicate the annual PM_{10} NAAQS (at 50 $\mu g/m^3$) was exceeded twice during the last six year period of record: once in 2000 at the North Rochelle No.1 monitoring station (at 50.8 $\mu g/m^3$); and once in 2001 at the North Rochelle No. E monitoring station (at 51 $\mu g/m^3$). This NAAQS may also be exceeded in 2002 at the North Rochelle No.1 and the Thunder Basin Coal No. 891 monitoring stations. The 24-hour PM_{10} NAAQS (at 150 $\mu g/m^3$) was also exceeded in 2001 at the North Rochelle No. 1 (268 $\mu g/m^3$) and the North Rochelle No. E (156 $\mu g/m^3$) monitoring stations, and so far in 2002 at the North Rochelle No.1 (211 $\mu g/m^3$) and the Thunder Basin Coal No. 891 (155 $\mu g/m^3$) monitoring stations. There is a possibility that these monitoring locations may also have exceeded allowable PM_{10} PSD Class II increments.

While these recent elevated values certainly warrant investigation, the nature of the exceedances and the possible interpretation as NAAQS violations is the responsibility of applicable air quality regulatory agencies, with EPA oversight. The background values used in the air quality analysis were determined through reviews with the regulatory agencies.

C-52: How were prevailing winds throughout the CBM emphasis area considered in the DEIS?

R-52: Prevailing and modeled winds were assembled, reviewed, and analyzed for the FEIS, and detailed in the Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-53: The projected emission levels presented in the DEIS are much lower than will actually occur. A full inventory of all relevant pollution sources must be incorporated; including: construction equipment (e.g., backhoes, bulldozers, and graders), compressors, diesel and gas generators, coal fires, as well as Wyoming and Montana cumulative emission sources.

R-53: The emissions inventory used for the DEIS was expanded to include large portions of southeastern Montana and northeastern Wyoming. Potential cumulative air pollutant emissions from "construction equipment (e.g., backhoes, bulldozers, and graders), operation and maintenance activities, compressors, diesel and gas generators, as well as Wyoming and Montana cumulative [RFD] emission sources" and reasonable foreseeable future actions, are documented in the FEIS Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-54: The modeling of the peak emission year appears to be a reasonable choice that is protective of human health, because long-term emissions are overestimated. However, several "conservative" emission factors appear to have been made, which are overestimates of emissions in most cases.

R-54: CEQ regulations (40 CFR 1502.22) require federal agencies to evaluate potential reasonably foreseeable impacts of an action, even in the face of unavailable or incomplete information. Where this unavailable information can not be reasonably obtained within the time frames of the analysis, "reasonable, but conservative" assumptions are used. For the air quality impact assessment, this includes estimates of background air quality conditions, the methods and timing of potential development, air pollutant emissions estimates, and even significance threshold levels. Where precise emissions information was not available reasonable assumptions developed in coordination with the regulatory agencies were used.

C-55: The DEIS does not provide adequate information regarding how air pollutant emission source were specified. For example, are these sources modeled as point, line or volume sources? If modeled as point sources, what stack characteristics were used (e.g. stack height, exit temperature and velocity)? How were particle size distributions specified? Drilling activities?

R-55: The FEIS presents summaries of the complete air quality impact assessment published in the Technical Support Document (Argonne 2002). This includes emission source characteristics, particle size assumptions, construction and operation assumptions, and the development scenarios addressed. In addition to the Technical Support Document, copies of the actual modeling files are available upon request.

C-56: The DEIS assumed that one well site visit per week would be necessary to refill the generator fuel tanks with either propane or diesel fuel. However, since diesel has a heating value nearly 1.5 times greater than propane, four fewer trips per well site would actually be needed in a three month period if diesel fired engines were used. This would generate much less fugitive road dust, contributing to PM_{10} impacts.

R-56: **See R-4.**

C-57: What is the technical basis (references) for potential emission and air quality impacts from the DEIS assumption: "Methane would be flared (burned off) continuously during the testing phase."

R-57: As described in the FEIS Technical Support Document - Air Quality Impact Assessment (Argonne 2002), it was assumed that CBM could be flared and exhausted to the atmosphere continuously for up to 24-hours in order to test the production viability of the well. Viable wells would then be connected to the pipeline distribution system; non-viable wells would either be closed-in for possible future development, or plugged, reclaimed and abandoned.

C-58: Are there local siting criteria to minimize air quality impacts from a well pad/wells?

R-58: As disclosed in the FEIS, further analysis of site-specific surface disturbing activity will be required (through either an APD or a Right-of-Way/Special Uses Permit), before any construction, testing or production operations can occur. Permitting agencies will consider siting and other mitigation measures to minimize impacts to air quality.

C-59: The Wyoming DEIS states "at any one time there may be as many as 400 portable diesel generators and 70 portable gas generators operating," however, the DEIS did not consider potential air quality impacts from these sources.

R-59: The FEIS Technical Support Document - Air Quality Impact Assessment (Argonne 2002) includes these sources in the air quality impact analysis, and describes potential air pollutant emissions from temporary/portable electrical generators until line power would become available at the well sites.

C-60: The average NO_x emissions rate of 1.5 g/hp-hr from ancillary generators during operation seems overly simplistic. Shouldn't the emissions rates vary during start-up and shut-down, or under varying capacities? How about during various phases of project development?

R-60: CEQ regulations (40 CFR 1502.22) require federal agencies to evaluate potential reasonably foreseeable impacts of an action, even in the face of unavailable or incomplete information. Specific information regarding air pollutant emission variations "during start-up and shut-down, or under varying capacities" is simply not available. Therefore the "reasonable" average NO_x emissions rate of 1.5 g/hp-hr assumption was used in the air quality impact assessment.

C-61: Considering the large amount of generation- and transportation-related fuel that will be burned in the extraction process, what would be the net energy gain from this development, and the air pollutant emissions equivalent of this demand?

R-61: Potential air quality impacts from the construction and operation of the Proposed Action and Alternatives (including the necessary fuel requirements, such as diesel-powered construction equipment, temporary well site generators, motor vehicle use, natural gas and electric compressors, etc.) were quantified and provided in the FEIS Technical Support Documents - Air Quality Impact Assessment (Argonne 2002).

C-62: It is possible that natural gas-powered equipment may not be available when the project begins, or may not be economical. Why can't diesel-fired generators be used temporarily during the de-pressuring phase?

R-62: The use of natural gas-fired equipment would be required to reduce air pollutants. **See R-59**.

C-63: Since electric compressors were considered as an Alternative in the Wyoming DEIS, why did the Montana DEIS ignore this option? However, if included in the Montana DEIS, the analysis should describe if the necessary electricity would come from one of the nearby coal-fired power plants, or be generated on site.

R-63: The Montana DEIS and FEIS Alternative D specifically states "Natural gas engines with electric booster would be required for all compression operations." Given the large number of RFD electrical generation projects included in the air quality impact assessment, it was assumed electrical line power would be available to operate electrical field (booster) compressors.

C-64: It is not clear how secondary sulfate and nitrate impacts were reported. Apparently the RIVAD/ARM3 chemical transformation scheme was applied, but were secondary aerosol concentrations produced by size range? Did the reported $PM_{2.5}$ and PM_{10} concentrations include both primary and secondary particles?

R-64: When comparing potential particulate matter impacts to the ambient air quality standards, secondary particulate matter was added to both the primary $PM_{2.5}$ and PM_{10} predicted concentrations (assuming that all secondary particulate matter was less than 2.5 microns in effective diameter). However, when potential visibility impacts were determined, the primary particulate matter was assumed to be either $PM_{2.5}$ or the "coarse" fraction between $PM_{2.5}$ and PM_{10}, whereas potential sulfate and nitrate impacts were calculated separately (due to their higher extinction efficiencies). Modeling details are given in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-65: What trace contaminant impacts would occur from fugitive emissions of organic condensate, sulfur and radon from the exploration, development and production activities? In one place the DEIS states that the natural gas does not contain sulfur compounds, and in another that methane migration could drive oxygen out of the soils and produce toxic levels of sulfur. Potential worker safety issues raised by these contaminants should be addressed in the DEIS.

R-65: CBM resources are essentially pure methane gas; there would be no significant quantities of condensate or sulfur contaminants. There is a potential for the biologic formation of hydrogen sulfide due to methane migration in older fields, but the controlled extraction of CBM would reduce that migration. The potential for hazardous air pollutants (HAPs) from CBM and conventional oil development was quantified and provided in the Technical Support Document - Air Quality Impact Assessment (Argonne 2002). Delineation of the extent metals and radiological contaminants that may be found naturally in the CBM emphasis area's soils, was not performed.

C-66: Why did the DEIS omit accidental or transient air pollutant releases in the emissions inventory? Significance exists if it is reasonable to anticipate the cumulatively significant impact, and merely terming an action temporary does not avoid the significance of the impact.

R-66: By their nature, accidental and natural releases of air pollutants are neither reasonably foreseeable nor subject to any health or environmental regulations. "Transient" or temporary air pollutant emissions during construction were quantified and provided in the FEIS and Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-67: The Proposed Action and Alternatives also create a serious risk of coal fires that can emit harmful air pollutants that must be assessed in determining potential air impacts.

R-67: It is true that accidental and natural coal seam fires have occurred for centuries throughout the Rocky Mountain West, and that they do release air pollutant emissions. However, the development of CBM resources is not expected to increase the "serious risk of coal fires that can emit harmful air pollutants. These emissions are not considered a reasonable foreseeable action.

C-68: The Montana DEIS does not provide adequate information to determine if far-field air quality impacts were analyzed. However, the Wyoming DEIS used the same modeling domain as in the previous DM&E New Railway Retrofit Project. What is the rationale for limiting the air quality analysis to the same study area as a railroad "retrofit" project east of the development area?

R-68: Both potential near- and far-field air quality impacts were addressed in the Montana DEIS (qualitatively) and FEIS (quantitatively). The two FEIS documents have been prepared using one combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-69: Fine particulate matter can travel a long distance in the atmosphere, resulting in significant human health impacts at remote population centers located outside the DEIS' modeling domain. The DEIS may not have identified the full impact of the Proposed Action and Alternative emission sources.

R-69: **See R-7 and R-42.**

C-70: The DEIS briefly mentions air quality impacts from dirt roads ("Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust ... and dust inhibitors ... could be used as necessary on unpaved collector, local, and resource roads ..."). However, the FEIS should clarify who will be responsible for ensuring, rather than simply encouraging, dust prevention measures to be taken. Just about all roads in the CBM emphasis area are subject to wind erosion. Is there a plan for controlling road dust? Regarding dust inhibitors, what are they and who will apply them? If water is to be used, what will be the source? Will dust management be conducted with high SAR water with it's negative impacts on plants? What chemicals will be used for dust suppression? What are non-saline dust suppressants? What will their impacts be on the environment?

R-70: Fugitive dust emissions from unpaved roads may be reduced by: vehicle use limits (reducing the number, speed or weight of vehicles); surfacing (with gravel, asphalt or cement); and application of dust suppressants (non-saline surfactants to increase road surface moisture, or binding road materials together to form a hard-packed surface). As stated in both the DEIS and FEIS "Particulate matter emissions from well pad and resource road construction would be minimized by application of water and/or chemical dust suppressants. The control efficiency of these dust suppressants was computed at 50 per cent during construction." This requirement would be part of the BLM approved APD, and may also specify the source and quality of water to be used. During production and maintenance, the Companies would not routinely employ dust abatement procedures on roads within the CBM emphasis area. However, the BLM does consider dust abatement during production activities and would require mitigation measures if necessary.

The determination of necessary road surfacing throughout the CBM emphasis area (and other dust abatement measures) is a legal responsibility of the applicable municipal, county, or state road departments, along with the applicable air quality regulatory agencies (once again with EPA oversight).

C-71: The DEIS states "To further reduce fugitive dust, operators could establish and enforce speed limits (15 mph) on all project-required roads in and adjacent to the Project Area." Merely considering some action is not adequate mitigation according to Council of Environmental Quality regulations. Could operators be required to post and establish speed limits and apply dust controls on unpaved roads pursuant to BLM's authority to prevent unnecessary and undue degradation under FLPMA?

R-71: FLPMA Section 302 directs BLM to regulate the "use, occupancy, and development of the public lands," and to prevent their "unnecessary or undue degradation." Therefore, it is within BLM's authority to regulate the operation of CBM development to prevent "unnecessary or undue" air quality degradation from unpaved road fugitive dust emissions by requiring the Companies to maintain appropriate speed limits. This management action is considered in several alternatives and is also a feature of the Preferred Alternative E for BLM managed oil and gas leases. **See R-70**.

C-72: The DEIS assumed the use of water to control fugitive dust from roads. No data were provided regarding: traffic volume; the quantity and availability of water supplies in the CBM emphasis area to water all such roads; the effect of evaporation and the short-term nature of this solution; the high maintenance effort of this control measure; the additional air pollutant emissions from the watering trucks; and the additional cost of these efforts. Are vehicle travel distances, trips generated, and roadway lengths consistent?

R-72: Details are provided in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-73: The DEIS addressed fugitive dust from construction activities and during operation. Are there other pollutants of interest in this category?

R-73: The Technical Support Document - Air Quality Impact Assessment (Argonne 2002) addressed potential fugitive dust emissions during construction (i.e.; land clearing, road building, trenching, etc.) and operations (i.e.; well maintenance visits, coal mining activities, etc.). Other natural fugitive air pollutant emissions include CBM seepage, wildfires and coal seam fires, but these sources were not specifically included in the air quality analysis and may be considered part of the background concentration.

C-74: It is unclear how the transportation calculations were performed, but the DEIS apparently analyzed potential air quality impacts on the basis of traffic volume generated from project-related trips only. This omits existing residential, recreational, and additional traffic generated by population growth induced by the proposed project. Specifically, how did the DEIS address the additional number of roadways to be created, the number of project- and non-project related vehicle use of these roadways, and the residential or commercial development on nearby lands?

R-74: According to EPA's "Compilation of Air Pollutant Emission Factors" for unpaved road fugitive dust emissions (available online at: http://www.epa.gov/ttn/chief/ap42/ch13/), vehicle speed and weight, and road surface moisture and silt content were the most significant factors in predicting fugitive dust emissions. However, other than paving or other surface treatment of public roads (which is outside the jurisdiction of BLM), the principle factor that could be mitigated is vehicle speed The description of modeling assumptions recognizes that induced or secondary growth related increases in vehicle miles traveled aren't included in the emissions inventory and model. See R-72.

C-75: Given the proposed well density, it is likely that all the grass would be contaminated with fugitive road dust. Local residences (ranches) are extremely vulnerable in these areas - dust will ruin our grass and harm our livestock. In Wyoming, CBM development-related traffic on a gravel road through our pasture has smothered us in Dust! Our animals have all been sick with respiratory problems.

R-75: **See R-1 and R-70**.

C-76: The DEIS did not describe the connection between air quality and health, both for workers and the general public, including air pollution impacts on mortality and morbidity from the particles, SO_2 and NO_2, within and beyond the CBM emphasis area. Differential health effects to sensitive sub-populations should also be considered. Recent studies demonstrate there is no threshold demarcating safe from unhealthy air; continuous damage functions should be used to evaluate the costs of increased air pollution, and the benefits from pollution reductions.

R-76: As disclosed in both the DEIS and FEIS, the NAAQS represent "the allowable concentrations of pollutants in the air specified by the federal government. The air quality standards are divided into primary standards (based on air quality criteria allowing an adequate margin of safety requisite to protect the public health) and secondary standards (based on air quality criteria allowing an adequate margin of safety to protect the public welfare) from any unknown or expected adverse effects of air pollutants." The primary (health) standards are designed to protect the health of sensitive populations, such as asthmatics, children, and the elderly.

Worker health is protected by standards promulgated and enforced by the U.S. Department of Labor, Occupational Safety & Health Administration (OSHA). BLM conducted or authorized activities must also comply with applicable OSHA regulations and standards.

Finally, an analysis of the "threshold demarcating safe from unhealthy air" and the use of "continuous damage functions ... to evaluate the costs of increased air pollution, and the benefits from pollution reductions" is clearly beyond the scope of the analysis .

C-77: The DEIS included no estimates of uncertainty in the estimation of air pollutant emissions factors and air quality modeling results. This is inadequate and incorrectly implies a level of certainty that defies physical reality. For example: a single year's meteorology was used; the actual location of wells, construction sites, roads and compressors was assumed; emissions will vary continuously; and the reactive chemistry of secondary particle formation is uncertain. The degree to which the anticipated development reflects emission factor limitations should be described. Deviations from these conditions should be noted and the impacts of these deviations described.

R-77: When reviewing these predicted air quality impacts, it is important to understand that reasonable assumptions were made regarding potential resource development, based on discussions with the regulatory agencies. In preparing this analysis, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations). The analysis was also based on a RFD scenario, including several assumptions as disclosed in both the DEIS and FEIS.

An exhaustive analysis of: multiple years of meteorology; temporal variations in emissions; "the reactive chemistry of secondary particle formation;" and "deviations from these conditions should be noted and the impacts of these deviations described" is clearly beyond the scope of the analysis. Furthermore, specific information necessary to identify "the actual location of wells, construction sites, roads and compressors" and "the degree to which the [actual] development reflects emission factor limitations" is simply not known at this planning analysis level. Accepted modeling protocol was developed in coordination with the regulatory agencies.

C-78: Although the DEIS states "all NEPA analysis comparisons to the PSD ... increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD Increment Consumption Analysis..," it did not analyze any PSD increment consumption. Who is going to do the comprehensive PSD analysis, and will it include all the related development projects?

R-78: Under both FLPMA and the CAA, BLM is required to assure that its actions (either direct or by use authorizations) comply with all applicable local, state, tribal and federal air quality requirements, including PSD Class I and II increments. Therefore, it is very appropriate for the NEPA analysis to indicate if potential direct, indirect and cumulative air pollutant emission sources are likely to exceed PSD increments.

However, there is a formal regulatory process used to quantify PSD increment consumption, including the establishment of baseline pollutant concentrations, identifying which air pollutant sources consume increment, and using defined analysis methods to quantify actual PSD Increment Consumption. Therefore, as disclosed in the FEIS, "all NEPA analysis comparisons to the PSD ... increments are intended to evaluate a threshold of concern, and do not represent a regulatory PSD Increment Consumption Analysis..." It is the responsibility of the applicable air quality regulatory agencies to conduct a PSD Increment Consumption Analysis, with EPA oversight.

C-79: Population densities within and outside the CBM emphasis area vary widely. Did the air quality impact assessment address this issue?

R-79: Neither the DEIS nor the FEIS addressed air quality issues specifically in regards to population densities. A detailed description of assessment is provided in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002).. .

C-80: Why does Table 4-7 of the Wyoming DEIS Technical Support Document (Argonne 2001) only list mandatory federal Class I areas, but also mentions the review of potential visibility impairment in certain Class II areas as well? For example, Devil's Tower National Monument is not listed in Table 4-7, but it appears to be the area of concern closest to the development project. Will increased transportation emission sources impact these Class I areas?

R-80: As disclosed in both the FEIS and its Technical Support Document - Air Quality Impact Assessment (Argonne 2002), potential visibility impacts from the Proposed Action and Alternatives were analyzed in several areas, described as "sensitive" by their managing agencies, including: mandatory federal PSD Class I areas; the Northern Cheyenne tribal designated PSD Class I Area; and numerous PSD Class II areas, including Devils Tower. However, both the National Visibility Goal and EPA's visibility protection regulations apply only within 156 of the mandatory federal PSD Class I areas designated by the U.S. Congress on August 7, 1977. A site-specific analysis of potential "increased transportation emission sources" impacts to these areas is beyond the scope of the analysis (as specified under 40 CFR 1501.7).

C-81: The DEIS should have disclosed potential atmospheric deposition impacts to sensitive lakes in the Big Horn and Wind River mountains. We found no mention of this potential impact in the DEIS. In addition, more detail is needed in describing the ANC analysis methodology than was provided in the DEIS. Are there other air pollutants beside nitrogen and sulfur which can affect sensitive lakes?

The lake nearest the proposed Wyoming Project Area is also the most sensitive; should this be a concern? How was the distance determined? Are there other lakes which should be analyzed (such as lakes on National Park Service or U.S. Fish & Wildlife Service lands?

R-81: The Technical Support Document - Air Quality Impact Assessment (Argonne 2002) analyzed and disclosed potential atmospheric deposition (acid rain) impacts at six lakes within the Wind River Range, two lakes within the Absaroka and Beartooth Ranges, and two lakes within the Bighorn Range. All of these lakes were identified as sensitive to atmospheric deposition by the Forest Service, but no additional lakes were identified for analysis in these mountain ranges. The FEIS and Technical Support Document (Argonne 2002) provide additional details on the impact analysis process.

C-82: The DEIS did not describe atmospheric deposition impacts as monitored by the National Atmospheric Deposition Program, with monitoring locations at Newcastle, Wyoming, or at the Little Big Horn Battlefield National Monument, Montana. BLM must thoroughly examine the impacts of increasing nitrates on surrounding ecosystems.

R-82: See R-81. Monitoring data are available from the National Atmospheric Deposition Program website at: http://nadp.sws.uiuc.edu/nadpdata/. Other than the increasing trend of inorganic nitrogen at BLM's Newcastle, Wyoming, monitoring site (averaging 1.7 kilograms per hectare per year, or kg/ha-yr; ranging from 0.8 to 2.5 kg/ha-yr), four other locations either showed no trends, or lowering trends in sulfate ion (averaging from 1.5 to 3.5 kg/ha-yr), inorganic nitrogen (averaging from 1.0 to 1.75 kg/ha-yr), and field pH measurements (averaging from 5.0 to 5.2).

C-83: The DEIS appropriately noted the potential for visibility and atmospheric deposition impacts within sensitive Class I and Class II areas located in this region, but no further effort was made to provide an quantitative analysis that would resolve these air quality concerns.

R-83: A quantitative analysis of potential visibility and atmospheric deposition impacts within sensitive Class I and Class II areas located in the CBM emphasis area has been included in the FEIS, as detailed in its Technical Support Document - Air Quality Impact Assessment (Argonne 2002). **See R-81**.

C-84: The DEIS did not describe visibility conditions throughout the CBM emphasis area as monitored by the Interagency Monitoring of PROtected Visual Environments (IMPROVE) Program, which have demonstrated that nitrate levels for the worst visibility impairment days are increasing at an alarming rate. The DEIS should analyze the potential for "plume blight," using the VISCREEN model.

R-84: As one of the founding agencies of IMPROVE, BLM is well aware of its visibility monitoring program, and the national monitoring trends. In addition, the visibility impact analysis included in both the DEIS and FEIS were indeed based on "natural visibility conditions" derived from the IMPROVE optical and aerosol data bases (used in the seasonal Federal Land Managers' Air Quality-Related Values Workgroup [FLAG] screening method), and actual hourly observed optical data collected in the Badlands and the Bridger wilderness area (used in the daily FLAG refined method).

A review of IMPROVE visibility data collected in the Project Area since 1988 (Malm 2002; http://vista.cira.colostate.edu/improve/Publications/Reports/2000/2000.htm) shows no significant change (either deterioration or improvement) at the Bridger Wilderness Area, but significant improvements in the "clear" days at the Badlands Wilderness Area and Yellowstone National Park. An additional review of bi-weekly nitrate ion concentrations collected by IMPROVE aerosol samplers from March 1988 through November 2001, show that the 2000 ad 2001 annual minimums (occurring in the fall) were greater than all previous years, but the 1999 maximum (occurring in the spring) was the lowest of all thirteen years, and the 2000 maximum was lower than four other years on record. Details are provided in the combined Montana and Wyoming Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-85: The Wyoming DEIS uses 1.0 dv as a "just noticeable change" visibility impact threshold, but the deciview metric is not easily related to gaseous and aerosol concentrations.

R-85: The Technical Support Document - Air Quality Impact Assessment (Argonne 2002) compared the seasonal FLAG screening method results to 0.5 dv at the request of the Wyoming stakeholder group, the daily FLAG refined method compared potential impacts to the 1.0 dv "just noticeable change" significance threshold, as described by Pitchford and Malm (1994) and required by the EPA Regional Haze Regulations. Although it is logical more days would be predicted to exceed half of a "just noticeable change" threshold (0.5 dv), these additional days would not normally be perceptible. Potential changes in gaseous and aerosol air pollutant concentrations were reported in the FEIS. However, potential visibility impacts from changes in gaseous and aerosol air pollutant concentrations are not linear. Therefore, the dv metric (Pitchford and Malm 1994) was used to indicate potential changes in visibility

C-86: Can hydrocarbon emissions forming organic aerosols which impair visibility? Are there other pollutants that should be included in the visibility impact analysis? Other secondary pollutants?

R-86: Since produced natural gas is nearly pure methane, with little or no liquid hydrocarbons or sulfur compounds, direct VOC emissions, objectionable odors, or secondary organic carbon aerosols are not likely to occur.

C-87: Are there meteorological factors which contribute to a day v. night visibility issue? The DEIS should define what is considered to be a significant visibility impact. The National Park Service considers any exceedance of 0.5 dv to be significant. Use of the 1.0 dv value ignores those days when a perceptible change in visibility may occur at lower thresholds.

R-87: **See R-85**. Air pollutant concentrations and relative humidity conditions predicted to occur at night were assumed to occur in daylight. In fact, daylight conditions can only occur between 8.75 and 15.5 hours per day throughout the CBM emphasis area. The FEIS compared potential direct, indirect and cumulative visibility impacts from the Proposed Action and Alternatives using the seasonal FLAG screening method (based on both the FLAG and WYDEQ-AQD relative humidity and background total optical extinction "natural conditions"), as reported in the Technical Support Document - Air Quality Impact Assessment (Argonne 2002).

C-88: The DEIS does not address potential impacts to climate, and the calculation of the "so called" greenhouse gas potential is not mentioned. For example: Will all of the methane emissions be reduced if coal mining follows the predicted course? Which of the underlying coal beds will be mined? Will releases during exploration and well development be greater than that released from future surface mining? Where are the potential leaks in this process? What is the expected greenhouse gas equivalent of methane leakage? Will production gas be "flared" if a well is not connected to a pipeline, or if a pipeline is not available to transport gas to market? Does the formation of CO_2 by burning the pipeline gas compensate for the fugitive methane emissions?

R-88: Given the preliminary and speculative nature of potential air pollutant emissions from the Proposed Action and Alternatives, it simply is not possible to quantify the potential "greenhouse gas emissions, and their possible effects, that will reasonably result from the project alternatives (including both direct project emission, and by producing fuels that will ultimately be burned)." Although the proposed Alternative's project sources and non-project sources emit carbon dioxide and methane, climate impacts are anticipated to be small from implementation of any of the proposed Alternatives. Climate impacts may even be beneficial to the extent that: Development of the CBM resource reduces the natural emissions of methane from coal mines. Additionally, the use of CBM displaces combustion of coal or oil, both of which emit more carbon dioxide than methane per unit energy produced. Finally, details regarding actual operations such as flaring, can not be adequately quantified and thereby are excluded from the analysis. It may be simply assumed that the purpose of CBM development is to recover gas and flaring will therefore be minimized by companies.

C-89: The DEIS did not examine all viable alternatives and mitigation strategies to further reduce potential air quality impacts as required by NEPA. The Wyoming BLM suggested only two mitigation strategies..

R-89: The DEIS included "viable alternatives and mitigation strategies to further reduce potential air quality impacts as required by NEPA," See Chapter 2 discussion on the development of alternatives.

C-90: The BLM should require all new development to use the most modern and least-polluting equipment reasonably available. Further committed mitigation measures should include: diesel retrofit or re-powering technologies on all heavy-duty diesel engines; requiring all diesel engines to use low sulfur diesel fuel; rigorous emission standards on all diesel-powered generators; a prohibition of venting or flaring methane wells; requiring flue gas injection to enhance CBM production, and to sequester CO_2 emissions; and an examination of alternative energy sources to provide necessary project power (alternatives include the use of solar panels, renewable energy technologies, and hydrogen fuel cells).

R-90: The U.S. Congress has limited BLM's authority to require air pollutant emission limits on the actions it authorized under FLPMA. In addition, the U.S. Congress has delegated implementation of the CAA (including the determination of appropriate control measures) to applicable local, state and tribal air quality regulatory agencies, with EPA oversight. BLM simply does not have legal authority to enforce the CAA, such as requiring "all new development to use the most modern and least-polluting equipment reasonably available.

C-91: Northern Cheyenne tribal lands are designated as a PSD Class I Area, but the DEIS did not identify any mitigation measures necessary to protect that special status. Pennsylvania Power & Light monitors air quality on the northern boundary of the Reservation to protect the pristine air quality from power plant discharge. If air quality problems occur from CBM development, similar monitoring (with associated costs) will also be necessary along the southern boundary of the Reservation.

R-91: Both the FEIS and its Technical Support Document - Air Quality Impact Assessment (Argonne 2002) described potential air quality impacts to the Northern Cheyenne designated PSD Class I Area. The FEIS also identifies management features in the Preferred Alternative to mitigate air quality impacts, including specific measures in the Northern Cheyenne Mitigation Appendix and the Air Quality Modeling Appendix.

C-92: The DEIS did not address noise abatement in both residential and industrial (occupational) areas, nor the impact of occasional road maintenance. Noise and air quality impacts must be maintained below the minimal levels prescribed in DEIS Table 2-2 (Alternative Management).

R-92: In addition to the requirement for electrical compression if noise levels exceed the thresholds identified under Alternative E (Preferred Alternative), the following potential mitigation measure has been included for all other Alternatives: Where noise impacts to sensitive receptors is an issue, noise levels could be required to be no greater than 50 decibels measured at a distance of one-quarter mile from the appropriate field (booster) compressor. This may require the installation of additional engineering controls at these locations.

C-93: The quiet in the CBM emphasis area is priceless now. Fifty decibels may not seem like much in Washington, DC, but it is noisy here. Compressor stations should be required to use the best available technology on these noisy engines, no matter what the cost, and compressor stations should not be placed within one mile of habitable buildings. What are the penalties if the 50-decibel level is exceeded?

R-93: Although the federal Noise Control Act was passed in 1972, there are no applicable federal ambient noise standards. EPA has identified noise levels of 55 decibels outdoors and 45 decibels indoors as preventing activity interference and annoyance. These levels of noise are considered those which will permit spoken conversation and other activities such as sleeping, working and recreation, which are part of the daily human condition. EPA has also estimated that 50 decibels is a typical average for a small town, suburban environment.

Although the State of Montana's only noise standard is related to occupational health and safety (Montana Environmental Quality Rule 17.74.101), which limits noise between 90 and 115 decibels, Montana's Major Facility Siting Act, and Air Quality Permits for Portable and Stationary Sources, all require a description of anticipated peak and average noise levels, and a description of the mitigative measures to reduce noise impacts. As part of these permits, Companies may be required to apply Best Management Practices to reduce potential noise impacts.

Cultural Resources

Comments and Responses

Comment 1 (C-1): CBM development will affect archaeological resources. The richness and importance of these resources is not presented in the DEIS.

Response 1 (R-1): Archaeological sites, which are included in the term Cultural Resources in the report, are addressed in the FEIS. The FEIS illustrates the rich archaeological heritage in the Powder River and Billings RMP areas (see Chapter 3, Cultural and Historical section), where it is estimated that 364,535 archaeological sites should exist in a 13-county region. This section also highlights archaeological site diversity in the study area and the potential time depth of archaeological sites.

Cultural resources are unique to a particular area. During the leasing process, known important cultural resources areas are either excluded from the lease or protected by the use of a No Surface Occupancy stipulation. However, if important cultural resources are identified after issuance of a federal lease, they are avoided or mitigated through data recovery.

Under the National Historic Preservation Act (36 CFR 800(a)(1)), Native American Graves and Repatriation Act, and other laws and regulations concerning cultural resources, Native American locations and other cultural locations, such as archaeological sites, must be evaluated for their importance. Sites and locations that are determined significant must then be mitigated—preserved from damage or professionally excavated to recover information that might be lost. Because of the high cost of excavation, most CBM projects would be designed so that archaeological sites are not disturbed. Significant Native American locations are also considered and measures taken to preclude or reduce disturbance.

As stated earlier, the exact mitigations will be designed for the site-specific locations.

C-2: Why were cultural resources treated similarly and equally in terms of type, composition, and significance, when cultural resources are not equal in significance?

R-2: Cultural resources are treated similarly and equally in the EIS to generate a general understanding of potential impacts from CBM development under various alternatives. The FEIS does acknowledge that cultural resources are not equal in significance, as stated in Chapter 4, Cultural Resources.

Specific cultural resources and how they might be impacted are not determined until site-specific drilling or development plans are proposed.

C-3: The DEIS also relies on incomplete, outdated, and misleading information about the potential for cultural resources and is inadequate; it is based on reports, which in many cases are outdated.

R-3: Archaeological site information used in the report was supplied by the Montana State Historic Preservation Office (SHPO), which maintains a register of all identified sites within each of Montana's counties and all sites that are listed or eligible for listing on the National Register of Historic Places (NRHP). Additional information was obtained from BLM survey data.

C-4: The DEIS states, "Lease stipulations, which require inventory and mitigation measures, can benefit cultural resources by delineating and minimizing adverse impacts on the resources." How would lease stipulating provide protection to cultural resources?

R-4: Both the BLM and the State oil and gas leases include a stipulation that requires a survey or inventory be conducted before approval of permits authorizing surface disturbing activities.

C-5: A fundamental problem exists in the BLM's leasing process. When a "split estate" situation occurs, BLM and the operators are required to conduct cultural resource surveys. The title to any discovered cultural resource belongs to the surface owner and any cultural resource evaluation and/or monitoring would have to be conducted with the surface owner's consent.

R-5: If a landowner refuses access to the BLM to conduct cultural resource work, the BLM still must comply with Section 106 before approval of a given APD is issued. BLM would notify the landowner that the APD approval would not be given until Section 106 responsibilities have been completed.

C-6: Surface occupancy is prohibited within paleontological sites on BLM minerals in the planning area. It seems that historic properties are not given the same consideration.

R-6: A cultural resource No Surface Occupancy (NSO) stipulation was adopted under the 1994 ROD for the oil and gas RMP amendment. This stipulation prohibits use and surface occupancy within sites or areas designated for conservation use, public use, or sociocultural use.

C-7: What, if any, binding stipulations exist regarding unknown cultural resources? If there are none, how will the RMP process afford historic properties reasonably effective consideration in avoiding, minimizing, or mitigating effects under the ROD for this EIS? Who is going to develop and implement a cultural resource location and significance model?

R-7: The lease stipulations that were adopted as part of the 1994 ROD for oil and gas RMP amendment for cultural resources include Lease Notice and a NSO measure. (See ***R-6*** for NSO explanation.) The lease notice states that the Surface Management Agency is responsible for assuring that the leased lands are examined to determine if cultural resources are present, and to specify mitigation measures. Guidance for application of this requirement can be found in NTL-MSO-85-1. The BLM typically requires a cultural resources inventory prior to submission of the APD to identify any unknown cultural resources. The results of the inventory are then used to decide the type of mitigation necessary for any discovered important cultural resource sites.

C-8: What specific approaches will be used in identifying, treating, and handling sacred, historic, and traditional cultural properties? The document leaves unaddressed the identification of appropriate mitigation as it relates to the divergent tribal interest, topography, and concentration of sites.

R-8: Project-specific mitigation of sacred, historic, and traditional cultural properties or cultural resources related to tribal interest, topography, and concentration of sites will be addressed with the Native American tribes who have an interest in the area being considered for development. If sacred or traditional sites exist in the area, the affected Tribe will be consulted prior to determining appropriate treatment. Additionally, the Preferred Alternative has included specific Native American mitigation measures for Cultural resource impact prevention (see Chapter 2).

C-9: How has this EIS process satisfied Section 106 and Section 110 requirements of the National Historic Preservation Act (NHPA)?

R-9: The FEIS is only part of the process toward meeting requirements of Section 106 and Section 110. The FEIS discloses the cumulative effects predicted to occur to cultural and other resources. The FEIS projects the number of cultural resources that could be impacted by total CBM development in the study area and Areas of Critical Environmental Concern (see Chapter 3 in the Cultural and Historical section). The FEIS also states that that important cultural resources must be considered and mitigated before CBM development takes place through either avoidance or mitigation (see Chapter 4, Cultural Resources section).

Site-specific impacts on cultural resources will be analyzed as part of the NEPA document prepared for each oil and gas action as required in the lease notice.

C-10: Shouldn't all of the parks and cultural sites in the state be listed? Will the Medicine Rocks State Park on Fort Keogh be listed? There are many more cultural areas that are not listed here.

R-10: Only the parks and designated cultural sites, such as BLM's ACECs, with the greatest possibility of being affected by CBM activities were listed in the document. Many cultural resource areas and sites are not listed in public documents to conceal their location to reduce the vandalizing and stealing of cultural sites and artifacts.

C-11: Why weren't the Northern Cheyenne and Crow addressed in the DEIS and why is the information that is included about the Northern Cheyenne and Crow misleading?

R-11: The Final EIS includes information provided by the Northern Cheyenne and Crow Tribes. Other information found in Chapters 3 and 4 was derived from the Ethnographic Study conducted for the EIS and from other published documents or websites.

Geology and Minerals

Comments and Responses

Comment 1 (C-1): What is the potential for coal bed methane resources being drained from unleased or undeveloped land that is contiguous to land on which CBM is being developed? What about the drainage of resources from federal land, state land, and Crow and Northern Cheyenne reservation land from development outside the reservation, as well as development of federal minerals within the reservation?

Response 1 (R-1): The possibility exists that drainage of unleased or undeveloped minerals contiguous to CBM development could occur, this would include tribal minerals. It is the mineral lessee's responsibility to investigate protective measures that are available. As part of BLM's trust responsibility to the tribes, BLM must identify if drainage may be occurring and inform the affected parties. Issues relating to the drainage of CBM resources from undeveloped lands are discussed within Chapter 4, Assumptions Common to All Alternatives, Geology and Minerals. BLM Project Plan requirements include provisions for operators to conduct drainage evaluations (modeling) prior to being issued an APD permit. Additionally, developments adjacent to the reservations will be required to maintain monitoring wells as prescribed by the BLM. Furthermore, if monitoring or reservoir modeling indicates drainage of CBM resources is occurring, the BLM would enter negotiations with the operator and the Tribe to protect the correlative rights of the Tribe. BLM requirements could include reducing production rates, shutting in the well, establishment of communitization agreements, or operator payment of compensatory royalty.

C-2: There is no discussion of methane drainage pertaining to the Northern Cheyenne Reservation in the Environmental Justice section.

R-2: The discussion of potential drainage regarding the Northern Cheyenne Reservation is contained in the Indian Trust Assets section of Chapter 4.

C-3: Concern was expressed over the buffer zones, or lack of buffer zones, around federal and state mineral resources and the appropriateness of buffer zones for development near reservation land. Also, how would mitigation measures be implemented if monitoring indicated that reservation resources were being drained?

R-3: The use of buffer zones and the implementation of mitigation measures relative to impacts on Tribal lands is discussed in Chapter 2 under Alternative E—Preferred Alternative; in Chapter 4, Indian Trust and Native American Concerns; and within the Monitoring Appendix. Further information is provided in the response to Comment 1.

C-4: There is a need for increased monitoring to protect the land surface and the land surface owner. The alternative adopted should incorporate efforts by operators to minimize surface impacts through the use of clustered well pads and production facilities, compensation to landowners for loss of land use, compensation to landowners for legal fees, the use of lease stipulations and conditions of approval, and the restoration of land once development and production activities are abandoned.

R-4: .Monitoring of oil and gas lease activities and subsequent impacts from those activities are an integral part and responsibility of the permitting agencies. The inspections are intended to determine compliance with approved permits and regulations, the effectiveness of mitigation measures, and the need to modify mitigation measures. Monitoring activities associated with different resources are described in the Monitoring Appendix of the Final EIS.

CBM operators are required by the BLM and the State to consult with private surface owners during preparation of Project Plans and encouraged to include Best Management Practices with their Plans. In addition to lease stipulations, agency requirements designed to reduce or eliminate impacts are described in Alternative E, Preferred Alternative of Chapters 2 and 4 of the Final EIS. A list of mitigation measures available to BLM and the State is found in Table MIN-5 in the Minerals Appendix of the EIS.

C-5: Agencies should require complete reclamation of all disturbed areas and sufficient bonding to cover the reclamation of land disturbed by CBM development and production. Will bonding be required to cover aquifer recharge or water depletion? Will bonding be required to cover weed control and to protect neighboring lands from the spread of weeds? Bonding requirements relative to CBM development should be clarified within the EIS.

R-5: Reclamation of disturbed areas is developed in consultation with the surface owner or surface management agency. Federal or State bonds are not terminated until reclamation work has been judged to be successful by the surface owner or surface management agency.

BLM and the State have the authority and flexibility to determine the appropriate amount of bond coverage for oil and gas operations. Many factors are considered by the agency when determining the amount of bond coverage. Regulations usually guide or determine when and how an agency can use the bond.

C-6: The impacts from CBM development in Wyoming should be included in the assessment of cumulative impacts relating to Montana CBM development. This should include an accurate assessment of the number of CBM wells projected to be developed in Wyoming.

R-6: The cumulative effects of Wyoming CBM production on Montana are addressed under the appropriate resource topics of Chapter 4. It is also included in the list located in the Minerals Appendix under the heading of Cumulative Projects Evaluated—Wyoming CBM Production. The EIS analyzed 50,000 projected CBM wells in Wyoming as part of the cumulative analysis.

C-7: Did the BLM consider CBM development on only BLM-administered oil and gas estate or on all lands covered by the EIS, including private lands? CBM development on private lands may impact state and BLM lands because of cumulative increases in road densities, traffic effects, air and water degradation, increased fire hazard, and many other factors.

R-7: The FEIS considers the impacts from future CBM exploration and development for all lands as part of the cumulative impact analysis.

C-8: Can mud from drilling be disposed of on-site without and owner permission? Who is responsible if damage occurs to adjoining land? Are radioactive materials used in fracturing fluids and what effect would they have on groundwater and subsequently on surface water after they are pumped back to the surface? Was the Alberta Energy and Utilities Board G-50 document, which addresses the disposal of oilfield waste, consulted when this study was being done?

R-8: The disposition of oil field waste is discussed in Chapter 4, Solid and Hazardous Waste, and in the Solid and Hazardous Waste Appendix. Generally, fracturing fluids consists of water and/or inert gasses such as nitrogen or carbon dioxide. These are not hazardous or radioactive and would not be expected to affect area groundwater. Fracturing fluids typically are recovered and stored in the site reserve pit prior to disposal. The fluids are disposed of in an authorized disposal facility. The Alberta Energy and Utilities Board G-50 document was not used as a reference because it deals with the disposal of drilling wastes in Alberta, Canada and does not have jurisdictional applicability in Montana. Agency responsibility for regulating solid and hazardous wastes is discussed in Chapter 1.

C-9: Are compressors used for activities other than pumping and drilling?

R-9: Compressors are used for the transmission of gas through pipelines as well as for drilling operations. The use of compressors is discussed in the Minerals Appendix, Reasonable Foreseeable Development Scenario—Alternatives B, C, D, and E, and in Chapter 4, Assumptions Common to All Alternatives.

C-10: Why was horizontal drilling not considered in the EIS, as the use of horizontal drilling would lessen surface impacts?

R-10: The use of horizontal drilling for producing methane from Powder River Basin coal seams has not proven to be successful with current technology and techniques, because of factors such as coal seam characteristics and the shallow depth.

C-11: All of the alternatives are based on an RFD scenario of 18,300 wells, despite the fact that the RFD scenario in the Minerals Appendix estimates that the RFD scenario may range between 10,000 to 26,000 wells. A recent promotional study for the CBM development industry (Anderson ZurMuehlin) forecast 9,550 wells in production over 10 years of CBM development, versus 18,300 over 20 years. Justification for the number used should be included in the EIS.

R-11: The RFD scenario in the Minerals Appendix accounts for all potential wells (26,300) of that 18,300 CBM wells are predicted to be developed on BLM and State minerals over the next 20 years.

C-12: What is the justification for using a predicted well life of 20 years?

R-12: A detailed explanation for an assumed 20 year well life is included in the Assumption Rationale section of Chapter 4 in the Final EIS.

C-13: A better estimate is needed of the number of wells predicted for Carbon County and their expected impact.

R-13: The number of wells predicted for Carbon County is based on current available data and included in the Minerals Appendix. The assumptions are based on coal volumes and gas content.

C-14: Is there any data available that would give anticipated production figures?

R-14: Predicted production numbers for CBM development within the Powder River Basin are included in the Minerals Appendix.

C-15: The DEIS uses a time period of 5 to 8 days for well installation and completion. J. M. Huber in a proposal for a test well in Gallatin County estimated "total days with rigs operating on location are estimated as 27 to 40 days."

R-15: The estimated 5 to 8 days for each well installation used the FEIS is an average based on best available data. Site-specific circumstances will result in differences to the average used. Gallatin County coals are deeper than Powder River Basin coals and will require longer periods of time to drill to such depths. Additionally the J.M Huber proposal calls for several wells to be drilled, not just one. Therefore, the total days may represent cumulative time if the wells are drilled in succession.

C-16: Why does Montana assume that all dry holes would be drilled in the first 5 years?

R-16: The RFD estimates that all dry holes will be drilled in the first 5 years because the majority of unknown or suspect CBM resources will be identified during this period of development. Most of the exploration holes will be drilled during this period, providing a better understanding of CBM resources in the Powder River Basin and resulting in reduced chances of drilling a dry hole.

C-17: Will diesel fuel or methane generated from CBM production be acceptable for fueling generators and compressors?

R-17: The types of fuels allowed under Alternative E are discussed in Chapter 2, Alternative E—Preferred Alternative and in Chapter 4, Air Quality and Climate. The use of produced methane or other natural gas for fueling generators and compressors is required under Alternative E as a means for minimizing impacts on area air quality.

C-18: Will beam-lift pumps be allowed for extracting CBM water?

R-18: There are no restrictions on the use of beam-lift pumps provided the provisions for air quality, visual, and noise resources are maintained in compliance.

C-19: Will hydraulic fracturing be allowed and if not, will it be made illegal?

R-19: A discussion of hydraulic fracturing is included in Chapter 4, Assumptions Common to All Alternatives. It is not anticipated that hydraulic fracturing would be part of the standard CBM completion practices and this EIS will not make it illegal for conventional oil and gas wells. Our assumptions for the EIS are that CBM operators would be allowed to use small amounts of water to "clean up" residue created by drilling operations from a potentially productive coal seam.

C-20: Please define the terms "deeper coal seam," "shallow coal seam," and "drill directionally."

R-20: The terms "deeper coal seam," "shallow coal seam," and "drill directionally" are discussed in Chapter 2, Alternative E—Preferred Alternative. The term "deeper coal seam" is used in the FEIS to designate a coal seam that is deep enough that it can be drilled to at a directional angle from a well pad in one spacing unit to another spacing unit. This avoids the need for constructing additional roads and well pads. The exact depth that the term "deeper" applies to is relative and will vary according to field spacing requirements and local geology.

The term "drill directionally" refers to the technique of drilling at an angle from a location at the surface to a different subsurface location at a specific target depth. The degree of angle that a well can be drilled is limited, which is why this technique is not employed for shallow coal seams.

The term "shallow coal seams" refers to those coal seams that are too shallow to drill to directionally given the area geology and spacing limitations.

C-21: How much energy does it take to develop and produce CBM? Is there a net energy gain or loss?

R-21: The amount of energy expended to drill and produce CBM would be less than the amount of CBM projected to be produced resulting in a net energy gain.

C-22: Where does the money from CBM development go?

R-22: Money derived from the sale of CBM is used to pay state and federal taxes and royalties; cost of developing the resource; employee wages; investment in future projects, and pay dividends to their investors.

C-23: What is the benefit to Montana from CBM development and how is the federal mineral royalty calculated? Should fiscal year 2001 federal mineral royalty data be included in the EIS?

R-23: Specific benefits to the State derived from CBM development are discussed under the heading of Socioeconomics in Chapter 3. Federal mineral royalties are based on the volume of product and product price, and are represented within the data contained in the Social and Economic Values section of Chapter 4 of the FEIS. Fiscal year 2001 data is not included because it was not available when the document was prepared.

C-24: Will the clustering of surface facilities, using mufflers for compressors, and using existing facilities be required to reduce resource impacts?

R-24: The clustering of facilities and sharing of roads and utility corridors to minimize surface impacts is required under all alternatives evaluated, as discussed in Chapter 4, Assumptions Common to All Alternatives. The use of mufflers and noise control provisions are discussed in Chapter 2, Alternative E—Preferred Alternative.

C-25: Why doesn't CBM fall under the same rules as other forms of natural gas and do existing oil and gas leases adequately consider mitigation measures and lease stipulations that would apply to CBM development?

R-25: Existing state and federal regulations addressing oil and gas lease operations also apply to CBM operations. Additional mitigation measures may be needed to address impacts from CBM operations. Oil and gas leases issued by the state and BLM can include stipulations to protect resources from oil and gas including CBM operations. BLM and state approved permits can include mitigation measures in the form of requirements or restrictions to proposed lease operations.

C-26: What is the percentage of federal leases within Rosebud, Custer, Big Horn, and Powder River counties that are likely to be leased for CBM development?

R-26: Federal oil and gas leases include the rights to explore for and develop all forms of oil and gas, such as CBM, unless specifically exempted in the lease. It would be difficult for BLM to predict the percentage of federal leases that would be issued for CBM development because the lessee is not required to provide that information until a drilling application is submitted to BLM.

C-27: Site-specific analysis must accompany every leasing and permitting proposal in the planning area to minimize impacts on all resources. This should include an integrated approach to resource protection. Project Plans should be mutually agreed upon rather than "developed in consultation." The tribe should be consulted on all Project Plans that would be implemented within the 1851 Treaty Boundary.

R-27: The requirement for developing and implementing a Project Plan for each proposed CBM development that includes more than one well per 640 acres is discussed in Chapter 2, Alternative E—Preferred Alternative. The Project Plan would be required to demonstrate how impacts on area resources would be minimized or eliminated.

A Water Management Plan also is required to be included in the Project Plan and must address how the operator would manage CBM-produced water to minimize impacts and comply with water quality laws. The Project Plan is to be "developed in consultation" with the affected surface owner(s) and other involved permitting agencies to allow all involved parties and agencies the opportunity to provide input and express their preferences on how resources should be managed and impacts minimized. It is, however, the responsibility of the CBM operator to implement the approved plan in accordance with applicable laws, lease stipulations, and permit conditions of approval.

Where CBM activities would affect reservation lands, CBM operators would be required to consult with tribal representatives in preparing the Project Plan and document the results of that consultation within the plan.

C-28: Maps for coal on the Crow Reservation indicate there is no coal capable of producing methane in the Little Bighorn Drainage. Additionally, clinker deposits are abundant on the reservation and Map 3-1 of the DEIS does not show any clinker outcrops. The EIS does not list the Monarch/Canton coal as being present in the Upper Tongue River Unit.

R-28: As shown in the Geology and Minerals section of Chapter 4 in the FEIS, coals that are potentially capable of producing CBM are present on the eastern edge of the Crow Reservation. The map in Chapter 3 does show that Wyodak-Anderson and Colstrip Coal clinker deposits are present on reservation land. These maps only show major clinker deposits. Undoubtedly, other minor clinker deposits are present that are not shown. The Monarch/Canyon is present within the Upper Tongue River Unit in the Montana portion of the Powder River Basin and is so indicated in Chapter 3, Geology and Minerals, Tongue River Member. The Monarch term is another name given to the Canyon section of the Upper Tongue River Unit.

C-29: Please clarify the use of the word "normally" as used under the heading Lands and Realty in Chapter 4. Include an option of ensuring, rather than simply encouraging, linesharing in the preferred alternative.

R-29: The use of the word "normally" within the text of the FEIS means "usually" but not necessarily "always." "Linesharing" is encouraged under Alternative E—Preferred Alternative, but because of site-specific circumstances may not always be possible. Project Plans will be evaluated to ensure that, where protected, "linesharing" will be accomplished.

C-30: Under the heading of Indian Trust and Native American Concerns in Chapter 4, an MBMG report is referenced with respect to a discussion of "methane liberation." The author of this paragraph used the MBMG report as a part of his/her basis for his/her assumption on "methane liberation."

R-30: The MBMG report was used as a source of information for the discussion of "methane liberation" and the distance that it might occur from a CBM well.

C-31: Within Chapter 3 it states the shales of the Colorado and Pierre Formations could perhaps accept produced water under injection pressures higher than fracture pressure. This statement should be clarified to explain the effects of fracturing a shale. Injecting at greater than fracture pressure fractures the formation and may cause communication with other members of the formation. Conventional oil and gas practices do not allow injection of water about the fracture gradient of any formation.

R-31: The comment is correct in that conventional oil and gas practices do not allow the injection of water above the fracture gradient of a formation when conducted to enhance oil or gas production. The referenced text, however, is meant to state that because of the characteristics of the shales and area geology, the disposal of CBM-produced water within a CBM water disposal injection well could perhaps be accomplished in these shale zones without exceeding the fracture gradient of the surrounding confining formations. The sentence has been removed in the FEIS.

C-32: Within Chapter 4 is a statement concerning the unknown location of exploratory wells. Haven't all the requests for exploratory wells been filled? Why aren't the locations known?

R-32: The referenced statement relates to the unknown location of future exploratory wells, not existing exploratory wells. The locations of existing wells are known.

C-33: Who has liability and responsibility for loss of life or property damage caused by explosions from CBM wells? Would the developer be liable for damage done other property or lands?

R-33: Liability for damage to property or loss of life resulting from CBM operations will depend on the particular circumstances of the incident.

C-34: What is the difference between communitization and unitization?

R-34: Communitization is pooling of mineral acreages, based on the spacing for a well or wells, set by the state or BLM. Unitization is pooling of mineral acreages proposed by a company to facilitate the efficient development of a reservoir based on geology and reservoir characteristics of a producing formation or formations.

C-35: What criteria will the MBOGC use to determine allowable spacing for CBM wells and what will be the response of the BLM and State in the event that CBM operators petition to have the well spacing acreage reduced?

R-35: Issues relating to well spacing are discussed in the Minerals Appendix. Requests by operators for adjustments to the spacing requirements would be evaluated on a case-by-case basis with the operator responsible for justifying the request. The primary factor relating to spacing adjustments would be the efficient drainage for a spacing unit by a well that is dependant on local reservoir parameters.

C-36: If there are three coal seams, would this result in more than one well per 80 acres?

R-36: Yes, if CBM is produced from more than one coal seam, there would be more than one well per 80 acres because a separate well would be drilled into each coal seam. Under Alternative E-Preferred Alternative, the separate wells in the 80 acre spacing unit would have to be located on the same well pad. Locating more than one well on a well pad reduces the number acres disturbed by construction and reduces impacts to other resources.

C-37: The EIS states that a Project Plan will be required if densities are greater than one well per 640 acres. Does this actually mean wells or well sites?

R-37: Project Plans would be required when the well spacing is less than one well per 640 acres. For example, when the spacing was changed to allow the drilling of one well per 160 acres, this would require a Project Plan.

C-38: How many wells can be permitted and still sustain the land and animal life that exists today?

R-38: The maximum number of wells that could be drilled and still sustain current resource levels was not analyzed in the EIS. Implementation of Alternative E-Preferred Alternative, including the mitigation measures and monitoring activities, would allow for the efficient and effective production of CBM while protecting and maintaining other resources and land uses.

C-39: Could MBOGC establish a phased-in number of CBM gas permits to be granted per year with ongoing monitoring by MDEQ, with the possibility of issuing future permits contingent on the level of impacts on air, land, and water?

R-39: Phased-in development as an alternative approach is discussed in detail in Chapter 2 under Alternatives Considered But Not Analyzed in Detail. The ongoing monitoring measures that will be conducted by various agencies and the operators are presented in the Monitoring Appendix. If monitoring indicates that impacts have occurred, operators would be required to implement measures for remediating impacted areas and mitigating future impacts.

C-40: The EIS identifies general operating standards and mitigation measures that will be applied to CBM development in Montana. BLM and the state should take advantage of the expertise and information acquired by the Wyoming offices. The Montana BLM and the state should review this information and incorporate, by reference if preferred, those measures that are applicable to Montana's future development.

R-40: Data from Wyoming was reviewed and, where applicable, used in developing the FEIS.

C-41: What are the rights of landowners versus mineral owners where split estates are involved? Will split estate surface use agreements between landowners and coal bed operators be required? Will every contractor working for the CBM operator be required to obtain access permission from the landowner? Can an operator or group of operators be denied access across state or federal lands of a lease? Chapter 3 discusses the liability of a "landowner" under the Comprehensive Environmental Response, Compensation, and Recovery Act (CERCLA). Who is a "landowner" in a split estate? Is the surface owner supposed to take the liability for the leasing action of the mineral owner? Please clarify this. In most cases of a split estate, the mineral owner is the dominant owner and the surface owner is subservient.

R-41: Split estate issues are discussed in Chapter 4 in Assumptions Common to All Alternatives and in Lands and Realty. Certain issues relating to split estates are also discussed in Chapter 3. Where split estates are involved, both the landowner and the mineral owner have certain rights. The mineral owner must enter into a surface agreement with the surface landowner, which sets forth the provisions under which the mineral owner will conduct drilling and development activities with respect to surface disturbances. The agreement also sets forth how the mineral owner or operator will minimize or mitigate surface disturbances.

The mineral owner or operator has the right to access provided that they enter into a surface agreement and comply with the provisions of their permit including any lease stipulations or conditions of approval. Under Alternative E—Preferred Alternative, a Project Plan would also be developed by the mineral owner or operator in consultation with the affected surface owner(s) and other involved permitting agencies to allow all involved parties and agencies the opportunity to provide input and express their preferences on how resources should be managed and impacts minimized. It should be noted that these provisions do not take effect at the time of leasing but rather are implemented when an operator submits an application to drill. Contractors working for the operator are also subject to the same agreements and provisions as the operator.

Issues relating to solid and hazardous waste are discussed in Chapter 3, Solid and Hazardous Waste; in Chapter 4, Solid and Hazardous Waste; and in the Solid and Hazardous Waste Appendix. The CBM operator is responsible for any and all activities associated with their equipment and materials.

C-42: How many monitoring wells will be required per CBM well, who would review the monitoring, and what are the actions taken if monitoring indicates impacts?

R-42: The Project Plan will be the vehicle for requiring monitoring wells installation by the CBM operator. Also, water monitoring wells will be installed by the state and BLM within the Controlled Groundwater Area. The required number of monitoring wells per CBM well will depend on the monitoring wells in existence when the plan is submitted. If impacts such as drawdown of groundwater below acceptable levels are identified, actions such as slow down of gas retrieval or re-injection of produced water may be requested of the operator. Also, the operator may be required to install a new deeper water well for the affected individuals under the provisions of their Water Mitigation Agreements.

C-43: Alternative A states, "The Crow Reservation can expect few impacts from CBM development within Montana under this alternative." Any impacts that could cause natural springs and water wells to be dry holes are significant impacts. Why is no monitoring planned for the Crow Reservation? It is stated in Chapter 2 that monitoring wells will be required for BLM-administered oil and gas leases near reservation boundaries. There is no mention of necessary monitoring wells associated with other than BLM-administered leases.

R-43: Monitoring requirements are presented in Chapter 2, Alternative E—Preferred Alternative, and in Chapter 4, Hydrological Resources. Groundwater monitoring is required for any exploration wells drilled on a BLM-administered oil and gas estate and any development wells drilled on a case-by-case basis. Regional monitoring requirements, beyond those required for the BLM-administered oil and gas estate, are discussed in the Monitoring Appendix.

C-44: Chapter 2 includes the requirement for groundwater monitoring if exploration wells are drilled within 2 miles of the reservation on a BLM-administered oil and gas estate. This language should be amended to apply only if a production or injection well is located within a 2-mile distance from the reservation.

R-44: The language in Chapter 2 is correct.

C-45: Will well spacing be completed to maintain underground aquifers for use by the surface owner or lessee?

R-45: The extraction of groundwater from coal seams is a necessary element for the production and development of CBM. Operators whose activities affect a landowner's water supply are required to enter into a water mitigation agreement with the landowner to provide an alternate source of water.

C-46: What agency(s) have authority over the regulation and permitting of CBM production and development? Tribal, Bureau of Indian Affairs, and EPA permitting requirements should be added to the EIS as they relate to tribal, allotted, and fee lands on and off the Crow Reservation.

R-46: Specific federal and state agency responsibilities with respect to CBM exploration and development are detailed in Chapter 1 of the FEIS. State and federal agency permitting responsibilities, including permit requirements on tribal lands, are set forth in Chapter 2.

C-47: Is BLM continuing to develop exploratory wells without NEPA authorization?

R-47: BLM has approved permits that authorize the drilling and testing of CBM wells on certain federal leases. An environmental analysis was completed and documented in accordance with NEPA before BLM approved these permits. BLM will continue to comply with NEPA before approving individual permits or project plans.

C-48: Methane is a volatile gas that has the potential to leak, seep, or migrate to existing water wells, core holes, and outcrops. The gas could potentially accumulate in buildings at volatile levels.

R-48: The potential for migration of methane would depend on site-specific conditions and will vary greatly from one CBM development area to another. The migration of methane to domestic water wells is a potential impact that should be identified in the Project Plan with appropriate mitigation measures.

C-49: The EIS discusses the venting and flaring of gas for up to 6 months. Will the existing venting occurring from monitoring wells be eliminated or captured? Can some of this gas be captured for sale?

R-49: Both the MBOGC and BLM have rules and regulations covering requirements for the venting and flaring of gas from wells. CBM operators would be required to follow these existing rules and regulations. The venting of gas produces such a minor quantity that it is not economical to capture the gas for sale.

C-50: Please provide more information on what would happen when there are existing, but not producing, CBM leases and an operator is looking to develop or expand a coal mine in the same location. Consider the effect of the 1-mile buffer suggested under some alternatives and lack of such a buffer in other alternatives.

R-50: Potential conflicts between coal mining and CBM operations are discussed in Chapter 4, Geology and Minerals. The issue of CBM development conflicting with coal mining operations would be addressed on a case-by-case basis during the approval process of the CBM operators' Application for Permit to Drill. Lease stipulations for No Surface Occupancy would be one means of resolving potential conflicts. Resolution of conflicts would be further guided by BLM Instruction Memorandum WO-IM-2000-081 (BLM 2000c). The FEIS also encourages voluntary cooperative agreements between CBM and coal mine operators to resolve conflicts. Under Alternative E—Preferred Alternative, no buffer zones would be present around active coal mines.

C-51: The alternatives presented are not adequate to protect resources. The RFD that was used for this EIS allows for too much development and has unacceptable associated impacts. A new alternative or a lesser RFD should have been created to provide an acceptable outcome.

R-51: The RFD presented in the FEIS was developed using a combination of historical trends, present activity, government and industry estimates, and professional judgment. The RFD is based on known resources of coal and the potential standard gas volume per ton. Therefore, a lesser RFD is not possible.

The alternatives presented in the FEIS to address the RFD were developed under two scenarios: restricted development (Alternative A) and expanded development (Alternatives B, C, D, and E). These alternatives meet the requirements of NEPA in evaluating potential development options and their impacts on area resources.

C-52: Land subsidence must be evaluated by the DEIS.

R-52: The drawdown of groundwater from CBM activities has been identified as the cause of surface subsidence in Wyoming (Case et. al. 2000). The subsidence was recorded as ½ inch and therefore does not represent an immediate impact to surface lands. In Montana where coal seams are thinner, subsidence would be less than what has been observed in Wyoming where coal seams are thicker.

C-53: The BLM DEIS inadequately confronts one of the most potentially disastrous issues related to CBM development: coal fires. The DEIS discusses the unlikely nature of coal fires increasing (or starting) by implying the completion of CBM wells create unfavorable conditions for the spontaneous combustion of coal. It also skirts the issue of expanding old or starting new coal fires along the edges of the basin (where dewatering exposes coal to air entry) by directing the reader to the unlikely event of coal fires starting because of CBM wells. This fails to adequately address the potential for more or new coal fires and inadequately covers air quality/coal fire concerns.

R-53: The Wyoming Geological Survey has published Coal Report CR 01-1, March 2001. The title is *Pyrophoricity (spontaneous combustion) of the Powder River Basin Coals—considerations for coal bed methane development*. This paper concludes, "During the production phase of CBM activity, conditions necessary to foster spontaneous combustion of coal are not present. After the coal seam is depleted of economic methane resources, wells must be plugged and sealed. Unlike abandoned mines, CBM wells leave no underground voids susceptible to further subsidence and associated spontaneous coal ignition." Finally, oxygen is required for combustion. Many pipelines and gathering lines have oxygen sensors that will shut in sources of oxygen greater than approximately 10 parts per million. Until they can drill exploration wells, our numbers are reasonable estimates.

C-54: The EIS estimates that 10 to 25 wells will be drilled in Park County and 1 to 15 in Gallatin County. J. M. Huber Corporation, which has leased minerals across 18,000 acres in Park and Gallatin counties, has repeatedly stated in public meetings that if gas is found, the company has plans to drill up to 130 wells in the area.

R-54: The RFD is based on known coal resources and used the standard volume of gas per ton of coal to calculate the potential number of CBM wells per county. J.M. Huber has yet to identify if any gas exists in Gallatin County for basing their well projections. Until they can drill exploration wells, our numbers are speculative.

C-55: It should be required that wells be drilled from multiple wellhead sites where possible.

R-55: The Preferred Alternative requires that operators develop multiple coal seam from a single location unless they can demonstrate in their Project Plan why this would not be feasible for that site.

C-56: Impoundments must be lined and treated as hazardous materials: fenced, posted, and monitoring wells installed.

R-56: Impoundments will have to meet the BLM and MBOGC's construction guidelines and monitoring requirements. Produced CBM water is not recognized as a hazardous material under the Toxic Substances Control Act nor as a pollutant under the Clean Water Act.

C-57: Adequate bonding for weeds might be one way to hold the companies more accountable.

R-57: BLM and the State have the authority and flexibility to determine the appropriate amount of bond coverage for oil and gas lease operations. Many factors are considered by the agency when determining the amount of bond coverage. Regulations usually guide or determine when and how an agency can use the bond.

Operators are responsible for the control of weeds that result from their lease operations. A weed management plan proposed by the operator must be submitted for approval by the permitting agency or the County Weed Board.

C-58: Injection wells should be required around private minerals like they are around Indian reservations.

R-58: Injection wells are not required around Indian reservations. They are, however, one of many possible mitigation measures that may be implemented if monitoring results indicate gas drainage is occurring. Private mineral owners can petition the MBOGC for protection of their minerals and for spacing changes if drainage is discovered on their assets.

C-59: CBM companies should be required to install hydrogen sulfide and methane monitors to anyone within an 18-mile radius with a water well.

R-59: This requirement was not incorporated into the Preferred Alternative because the data does not indicate that migration of methane or hydrogen sulfide is likely to occur.

C-60: It will likely take hundreds of years for some of the damages brought about by the proposed manner of development to be healed.

R-60: The Preferred Alternative incorporates many mitigation measures to reduce natural resource impacts and strike a balance between CBM development and sustained resource management. Reclamation of unavoidable impacts will be accomplished when the wells have reached the end of their productive life and have been closed. Replenishment of coal seam waters will take time.

C-61: The surface area where access to drilling, pipelines, and all connected infrastructure will be occurring must be considered.

R-61: The disturbance of surface acreage and access to private, state, and federal lands for infrastructure construction and operations has been considered in the impact analyses for each resource topic. Surface owner agreements will be used to determine locations of facilities and to draft an understanding between surface owners and operators regarding access.

C-62: If CBM is allowed to develop without sufficient amounts of baseline data in all of these areas, it will be difficult—if not impossible—to identify the exact cause of future natural resources problems.

R-62: Sufficient data has been collected and considered for this level of planning and decisions will use an adaptive mitigation approach for considering any new data that might change operating procedures.

C-63: What methods of recharging the aquifer are being considered? Who is going to reimburse the surface owners if they have to drill deeper for new wells? Is a numeric standard being proposed that will allow irrigators to continue growing crops that are their economic mainstay? Who will monitor and enforce these standards?

R-63: The water being pumped for CBM extraction is derived from the coal seam. Aquifers are required to be monitored for drawdown. Monitoring will be carried out by the BLM, State, and the operators. If results of monitoring indicate that unacceptable levels of groundwater are being removed from usable aquifers, steps will be taken to reduce or recharge the aquifer in accordance with the Controlled Groundwater Area order requirements. See the Monitoring Appendix for more details.

Operators are required to enter into a Water Mitigation Agreement with all water users in the area that might be affected by their CBM development activities. These agreements typically require the operator to drill a new deeper well or replace the water through some other acceptable means. See the Hydrology Appendix for more details.

No numeric standards are proposed in the FEIS, as they are not part of the scope of the project. The MDEQ is tasked with developing numeric standards for the surface water bodies in Montana that protect current users. The monitoring and enforcement of standards is the responsibility of the MDEQ and the operators per their permit requirements.

C-64: CBM development might pollute the ozone layer.

R-64: The release of CBM into the atmosphere and the potential degradation of the ozone layer from these actions has been addressed in the Air Quality Analysis. See Chapter 4 in the Air Quality and Climate section.

C-65: Monitoring should be required if the edge of a field is within 5 miles of a reservation boundary. The same should be extended to all lands within 5 miles of the edge of an exploratory or productive field.

R-65: The BLM has a trust responsibility that requires it to protect the Indian trust assets of affected reservations. The BLM needs to monitor and determine if these assets are being affected. The BLM and State must also determine what effect their proposed actions would have on other owners. The permitting agencies do have a responsibility to mitigate impacts caused by approved operations. Monitoring of each development field for various concerns will be conducted as outlined in the Monitoring Appendix.

C-66: The EIS needs to consider bonding similar to coal development.

R-66: Bonding requirements for BLM and the State are established by regulations. It would require legislation to change the bonding requirements which is outside of the scope of the EIS. BLM and the State have the authority and flexibility to determine the appropriate amount of bond coverage for oil and gas lease operations. Many factors are considered by the agency when determining the amount of bond coverage. Regulations usually guide or determine when and how an agency can use the bond.

Hydrological Resources

Comments and Responses

Comment 1 (C-1): What efforts are being made by BLM, the State, and CBM producers to protect ranching operations, particularly water?

Response 1 (R-1): The Montana DNRC issued an order that describes the authorities that pertain to CBM development and groundwater: *Final Order: In the Matter of the Designation of the Powder River Basin Controlled Groundwater Area.* A copy of the order is included as Appendix E of the Water Resources Technical Report (ALL 2001b).

The order outlines water rights issues, mitigation, monitoring plans, and jurisdiction with respect to CBM water production and use. CBM operators will be required to have an agreement with the private surface owner. The agreement should address operations on private surface. Water Management Plans will also be required by the MBOGC and BLM before approval to drill can be obtained. If a surface discharge is requested, the CBM operator will be required to obtain an Montana Pollutant Discharge Elimination System (MPDES) permit, which will take into account all beneficial uses. In addition, the state and BLM are installing a regional monitoring system and will require CBM operators to perform in-field monitoring of groundwater levels.

C-2: Is CBM-produced water of sufficient quality for watering livestock?

R-2: The Hydrology section in Chapter 3 includes discussion of water quality. Waters with a total dissolved solids (TDS) of less than 3,000 milligrams per liter (mg/l) are generally considered to be acceptable for livestock use (Bauder 1999). Coal seam waters from the Powder River Basin rarely contain TDS values in excess of 2,500 mg/l. Therefore, it is expected that in most cases the CBM-produced water will be acceptable for livestock use.

C-3: How much CBM-produced water can the livestock industry use?

R-3: The total surface area of the CBM emphasis area is 25 million acres (all owners) (WRTR, ALL 2000). If we assume that 84 acres are needed per cow per year (7 acres per AUM, a high number since all surface will not be used for grazing), then a total of ~300,000 cows could be supported by this range. If each cow drinks on average 20 gallons of water per day (more in the summer, less in the winter), then the total volume of water that could be managed by cattle would be 6 million gallons per day, or 4,167 gpm. The actual volume of water used by livestock will be dependent on a variety of factors, including location of livestock relative to CBM production, the number of and type of livestock, and water rights. In order to be approved the operators Water Management Plans must set out the disposal methods to be used, and/or the beneficial uses of the produced water. Such plans must be reasonable if they are to be approved.

C-4: How much additional land will be made available for livestock from CBM water and what impacts will this have on vegetation and wildlife?

R-4: This issue is discussed in the conclusions for Alternative C of the Livestock Grazing section of Chapter 4.

C-5: The EIS should address the infringement of water rights caused by depleting water wells and by degrading quality of stream water.

R-5: The EIS addresses issues related to loss of water rights in the Production section under Alternative B in the Hydrology section of Chapter 4. The discharge of CBM-produced water and the impacts on water quality are addressed in the discussions under Alternative C of the Hydrology section of Chapter 4.

C-6: The DEIS does not address monitoring of groundwater and surface water.

R-6: The Monitoring Appendix includes a discussion of the responsibilities for monitoring water resources.

C-7: Which governmental entity will protect the water supply?

R-7: The MDEQ is responsible for enforcing current water quality standards. Both the MDEQ and the MBOGC enforce the Water Mitigation Agreements required of every CBM operator.

C-8: What forms of water management will be required?

R-8: Under the Alternative E—Preferred Alternative, operators will be required to submit Water Management Plans (WMPs) which detail their proposed management. WMPs are discussed under Alternative E of the Hydrological Resources section in Chapter 4.

C-9: Will CBM water be fit for irrigation and for how long?

R-9: The extent to which CBM-produced water can be used without impacts on soil and crop production will vary based on site-specific conditions. The Soils section in Chapter 4 of the EIS discusses the impacts of CBM on crops and additional detail can be found in the Soils

Technical Report (ALL 2001a). The quality of CBM water is discussed in the Hydrology section of Chapter 4 and additional information can be found in the Water Resources Technical Report (ALL 2001b).

C-10: The DEIS offers no mitigation for the people dependent upon groundwater.

R-10: The DNRC order that established the Powder River Basin Controlled Groundwater Area discusses mitigation of impacts resulting from CBM development to groundwater resources. A copy of the order is included as Appendix E of the Water Resources Technical Report (ALL 2001b).

C-11: Some of the water resources in the area are not now suitable for irrigation.

R-11: Water quality conditions in some areas are currently unsuitable for irrigation. The water quality in the region is described in the Hydrological Resources section of Chapter 3.

C-12: The DEIS falsely claims that groundwater is used for irrigation.

R-12: The Water Resources Technical Report Exhibit 20 (ALL 2001b) and the Crow Indian Reservation report (Crow Tribe 2002) both provide information from the MBMG database on wells that are currently designated as having irrigation as their primary use. Based on this information, it is believed that some use of groundwater for irrigation occurs within the study area.

C-13: The DEIS presents no basis for determining the suitability of water for irrigation.

R-13: A discussion of the suitability of CBM water for irrigation is found in the Hydrological Resources section of Chapter 4 of the Final EIS.

C-14: Where in the DEIS are the mitigation impacts on sub-irrigation of hay-base on rivers and streams in southeastern Montana?

R-14: MDEQ is developing surface water standards to protect surface water quality for all downstream beneficial uses, including irrigated agriculture. Therefore, mitigation measures required to meet surface water quality standards will need to be sufficient to protect sub-irrigated hay base.

C-15: The DEIS does not address salinity or 22 other inorganic constituents in CBM water. What are the impacts of these constituents?

R-15: A complete water analysis will be required to be submitted with Water Management Plans, and with applications for MPDES discharge permits. These will not be approved unless all standards are met. As standards are intended to protect all beneficial uses there should be no impact from these constituents. The water quality of CBM-produced water is discussed in the Hydrological Resources section of Chapter 3. Additional discussion is also available in the Water Resources Technical Report (ALL 2001b). Impacts are discussed in the Hydrological Resources section of Chapter 4.

C-16: The two DEIS use markedly different sodium absorption rate (SAR) values; existing available data should be used to develop representative SAR and electrical conductivity (EC) values for each watershed based on median stream flow rates.

R-16: The states of Montana and Wyoming have coordinated the assumptions used in the FEIS. Analytical methods were also coordinated to ensure parallel impact analyses in both parts of the Powder River Basin.

C-17: Where did baseline surface water SAR and EC values come from?

R-17: Baseline surface water quality data used in this analysis was obtained from USGS online sources, including the web site: http://waterdata.usgs.gov/mt/nwis/monthly?search_criteria=huc_cd&submitted_form=introduction. Specific references to data sources are included in the tables or in relevant text.

C-18: The EIS needs to include an explanation as to the relationship between EC and SAR, the impacts of EC and SAR on soils, vegetation, what the Hanson curve means, and what it means to be above the line or below the line.

R-18: Detailed information regarding the relationship between SAR and EC can be found the in the Soils Technical Report (ALL 2001a) and the Water Resources Technical Report (ALL 2001b) This discussion has been added to the text of this document, and is contained in the SWQATR (Graystone and ALL, 2002). As before a discussion of this relationship is also included in the Soils Technical Report (ALL, 2001a) and the Water Resources Technical Report (ALL, 2001b). These technical reports are available on the MDEQ CBM web page at http://www.deq.state.mt.us/coalbedmethane/index.asp.

C-19: What is the effect of SAR on crops?

R-19: SAR does not directly impact plants. It affects soil quality and structure that does impact plant growth. EC has a more direct effect on plant growth. The effects of SAR and EC on crop production are discussed in the Soils Technical Report (ALL 2001a).

C-20: Water high in SAR will damage soils containing smectite; the DEIS does not address this.

R-20: The EIS discusses the impacts on soils from SAR in the Soils section of Chapter 4. Additional discussion can be found in the Soils Technical Report (ALL 2001a).

C-21: What is the optimum SAR value? Is a lower reading always better?

R-21: Generally, a lower SAR reading is better. There is no optimum SAR value. So long as the ratio of sodium to calcium and magnesium remains low clay structure should not be affected. If clay structure is maintained the ability of clay rich soils to infiltrate moisture will not be affected, and there is unlikely to be a decrease in crop yield. Additional discussion on this topic can be found in the Soils Technical Report (ALL, 2001a).

C-22: How much sodium is contained in CBM water? How much exists in the current surface waters?

R-22: The concentration of sodium and other constituents will vary in the CBM water produced across the Powder River Basin and in the coal seams outside the basin. The sodium load that surface waters carry varies over time as well. Average water quality for several coal seams and some surface waters are published in the Water Resources Technical Report (ALL 2001b).

C-23: Why does the DEIS not prevent discharge to protect those who live downstream?

R-23: The MDEQ is developing surface water standards to protect surface water uses for downstream users. It is the role of MDEQ to control discharges to surface water. Any discharge of CBM water to surface waters must meet water quality standards and discharge permits must protect beneficial uses for which the surface water may be used The MDEQ is addressing the issue of CBM discharge through the TMDL process, and therefore, it is not a part of this EIS. Information on the TMDLs is provided in the Hydrology Appendix.

C-24: Discharge permits should be reviewed annually and penalties put in place.

R-24: Details regarding how MDEQ will enforce General Discharge Permits are included in the Hydrology Appendix.

C-25: The alternatives are not sufficiently protective of stream quality from impacts by discharge to streams and by infiltration. What is the fate of water in impoundments? Will there be monitoring wells?

R-25: The Alternative E—Preferred Alternative was designed to protect surface water quality by requiring that all discharges meet MPDES permitting requirements. The fate of water in impoundments will depend on the design and siting of the impoundments, as discussed in the Hydrological Resources section of Chapter 4. Infiltration impoundments would be constructed with the intention that infiltrated water would recharge bedrock aquifers, and not allow produced water to be discharged to surface drainages. Such impoundments will be monitored to ensure that this is water is actually taking place, as outlined in the Monitoring Appendix.

C-26: How will discharge and infiltration permits be enforced and penalties assessed?

R-26: Information on the General Discharge Permits can be found in the Hydrology Appendix of the EIS.

C-27: What are the overall impacts on the Tongue, Powder, Rosebud, Owyhee, and Yellowstone rivers.

R-27: The overall impacts on affected rivers and streams can be found in Chapter 4 under the Hydrological Resources section.

C-28: If an ephemeral stream becomes a perennial stream due to CBM-produced water discharge, is this considered an impact on the water quality of the stream?

R-28: The impacts on ephemeral streams were analyzed in the Hydrological Resources section of Chapter 4. Ephemeral streams that become perennial because of CBM-produced water discharge must meet all water quality standards.

C-29: The DEIS does not adequately address the potential for spills and leaks from water containment basins.

R-29: The impoundments would have to be designed to contain a 25-year storm event, and meet other federal and state design and construction requirements.

C-30: The DEIS methods to analyze impacts on Powder River Basin streams do not account for the effect of receiving water chemistry (e.g., ambient calcium concentrations, carbonate equilibria, mineral solubilities, etc.) on the blended water chemistry.

R-30: Agree, the EIS impact analysis was developed using a simple mixing model that did not account for chemical reactions. This approach was chosen as the exact reactions taking place are not known. The mixing model and the drawbacks of the model are discussed in the Surface Water Quality Analysis Technical Report.

C-31: If the water quality of a stream has already been exceeded by Wyoming CBM production, will Montana allow discharge of CBM-produced water? Even a slight decrease in Tongue River water quality will impair its utility to irrigators.

R-31: The State of Wyoming has stated no CBM-produced water will be discharged into the Tongue River in Wyoming. (Refer to the letter from State of Wyoming in the Hydrology Appendix). The two states have also discussed a distribution of the assimilative capacity between Montana and Wyoming. However, no decision has been made yet on this issue. For any given stream, once the assimilative capacity has been met, no further discharge will be allowed. Therefore, it is possible that all of a streams assimilative capacity could be used up by Wyoming CBM producers, and no discharge could be allowed in Montana.

C-32: The 7Q10 flow rates should be used in the impact analyses in addition to annual average and low-flow mean and high-flow mean flows.

R-32: The surface water quality analysis has been modified such that impacts on surface water are now being analyzed for the 7Q10 flows and mean monthly flows, including low monthly and high monthly mean flows, at each USGS station being evaluated. These analyses are included in the Hydrology Resources section of Chapter 4 for the relevant alternatives, and are presented in detail in the SWQATR.

C-33: The DEIS does not provide an analysis of the amount of water infiltrating to shallow groundwater systems that will subsequently discharge to surface water bodies.

R-33: The amount of water that will infiltrate into shallow groundwater systems and eventually discharge will be dependent on site-specific conditions. This will be addressed in site-specific Water Management Plans and environmental assessments.

C-34: Baseline flow values listed in Table 4-7 of the DEIS may have already been impacted by CBM development in Wyoming. What about baseline flow values in Table 4-6 of the DEIS?

R-34: The impact analyses detailed in the Hydrological Resources section in Chapter 4 use historical surface water quality conditions to predicted impacts from Wyoming and Montana. Historical surface water quality data includes the bulk of the historical surface water data provided by the USGS was collected prior to the onset of CBM production in either Montana or Wyoming.

C-35: Explain how limiting CBM discharges to the irrigation season will protect the Tongue River, riparian vegetation, not result in flooding of streams from ice jams and flows as CBM freezes, impacts of such events on soils.

R-35: The limiting of CBM discharge to a specific time period would be a site-specific condition that would be included as part of a Water Management Plan. The MDEQ could write flow-based discharge permits that would tie discharge rates to flow conditions in the receiving stream. Flow-based permits would ensure that CBM discharges are diluted by sufficient quantities of stream water. These permits could only be granted after it was ensured that all beneficial uses were protected.

C-36: CBM operators should be required to re-inject produced water. The EIS alternatives should include deep injection and injection into non-productive coal seams. Does the EIS consider the Schneider re-injection plan, which is being used in other states such as New Mexico and Colorado?

R-36: The quality of the water produced with CBM makes it valuable for one or more beneficial uses. Neither BLM of the State want to waste this valuable resource by injecting into formations with water of a worse quality which would eliminate beneficial use of the water. Most of the water produced with CBM in the San Juan Basin of New Mexico and Colorado is of poor quality and not useable for beneficial uses without treatment. That produced water is injected into deep formations with water that is also not suitable for beneficial uses. Re-injection as described by Mr. Schneider is discussed in the Alternatives Considered But Not Analyzed in Detail section of Chapter 2 of the Final EIS.

C-37: The EIS should require remediation of the aquifer as a mitigation measure.

R-37: Aquifer restoration is included as one potential mitigation measure of CBM-produced water under Alternative E—Preferred Alternative, as detailed in Chapter 2.

C-38: The DEIS should discuss why re-injection would not work.

R-38: The EIS discusses why re-injection of water into actively producing coal seams will not work in Chapter 2 in the Alternatives Considered But Not Analyzed in Detail section.

C-39: The EIS should address injection into shallow aquifers and possible impacts.

R-39: The EIS does not exclude injection into shallow aquifers from the discussion of Alternative E (Preferred

Alternative) in the Hydrological Resources section of Chapter 4.

C-40: The EIS does not address the irretrievable loss of groundwater resources.

R-40: The Hydrological Resources section of Chapter 4 discusses impacts on groundwater resources including its irretrievable loss. The discussion of Alternative E (Preferred Alternative) places an emphasis on the beneficial use of produced water in an effort to minimize the loss of this resource.

C-41: Dilution of high-sodium, low-calcium water with other waters could increase the total supply of water available for fisheries and irrigation.

R-41: . Dilution of produced water with water supplied from other sources would result in an increase in available water. The discussion of Alternative E (Preferred Alternative) emphasizes the beneficial use of produced water activities such as dilution and supply to fisheries and irrigation, which could be considered beneficial uses.

C-42: What, realistically, is to be done with the high sodium water?

R-42: Water quality is one of the most important and limiting factors that determines viable management options or beneficial uses. When water quality, such as elevated sodium levels above protective standards, prevents the use of certain management options, then only other management options can be used.

C-43: Water not suitable for surface release is potentially not suitable for beneficial use.

R-43: Water quality is one of the most important and limiting factors that determines viable management options or beneficial uses. When quality prevents the use of certain management options, then only other management options can be used. The quality of the produced water may make it unsuitable for use in irrigation, but that same water could be used to water livestock or as a dust suppressant on roads.

C-44: The General Discharge Permit does not allow (or acknowledge) that water produced in coal bed natural gas development can be beneficially used for agriculture.

R-44: Under the proposed General Discharge Permit, livestock watering is considered a beneficial use, but irrigation of agricultural fields and rangelands is not. However, any water specifically suitable for irrigation use as determined by testing may be used and is not prohibited. The Water Management Plan could include this option.

C-45: Who will determine what a beneficial use of produced water is, and if no one has filed a beneficial use for the water, what will be done with the production water?

R-45: . Beneficial use of produced water should be determined jointly by the permitting agency, surface owner and operator. Beneficial uses of produced water will be detailed in Water Management Plans on a site-specific basis. The disposal of all water not beneficially used is discussed the Hydrological Resources section of Chapter 4 under Alternative E—Preferred Alternative

C-46: There will be no adverse effect to beneficial uses because Montana law prohibits discharge if there will be adverse effects.

R-46: Montana's "non-degredation" law and water quality standards are designed to maintain or enhance water quality and protect existing beneficial uses of state waters. Applicable water quality standards must be met before a MPDES permit is approved and water management plans will not be approved by BLM, without the corresponding discharge permits.

C-47: There is no definition of a water management plan.

R-47: Water Management Plans are discussed in Chapter 2 and complete details concerning requirements can be found in the "BLM Miles City Field Office Coal Bed Methane APD and POD Guidance Document."

C-48: Beneficial use should be left to the discretion of the operator.

R-48: .Beneficial use of produced water should be determined jointly by the permitting agency, surface owner and operator. Beneficial uses of produced water will be detailed in Water Management Plans on a site-specific basis.

C-49: Reservoir quality sands are present in the area that may be able to take re-injected CBM water. Why haven't they been studied or evaluated?

R-49: Deep injection and shallow injection are discussed in the Hydrological Resources discussion in Chapter 4. The Montana Bureau of Mines and Geology is currently studying these options for feasibility.

C-50: Where will CBM water come from for dust suppression and if water is going to be taken from the river for dust suppression, how will that affect water rights?

R-50: CBM produced water that could be used for dust suppression could be stored in tanks or impoundments to reduce or eliminate the need to take water from rivers. A water right is needed if water for dust suppression is to be taken from a stream or river.

C-51: Explain how large surface area of containment ponds emphasizes "beneficial use" of produced water from CBM wells.

R-51: Impoundments can provide a variety of beneficial uses including stock watering ponds, wildlife watering ponds, fishing ponds, and industrial use water. This is described in the General Discharge Permit on in the Hydrology Appendix.

C-52: Explain how infiltration of surface aquifers that degrade the quality of these aquifers emphasizes "beneficial use."

R-52: Infiltration of water that would result in the degradation of the surficial aquifers to a level in which it could not be used would not be considered a beneficial use. The infiltration of water that is of sufficient quality that this water may be used would be considered a beneficial use. The introduction of CBM water to shallow aquifers may degrade or improve the groundwater quality. The site-specific chemistry of the CBM water and the shallow groundwater would need to be evaluated for each proposed CBM project to determine if infiltration could be considered a beneficial use.

C-53: The EIS does not make a clear distinction between the potential impacts associated with using river water which receives produced water discharges under MPDES permits and the beneficial use of produced water for "managed" irrigation.

R-53: The EIS does not address site-specific issues. The use of produced water for "managed" irrigation would be detailed in a Water Management Plan for a site-specific beneficial use.

C-54: Is re-injection a beneficial use?

R-54: The injection of water for aquifer recharge or aquifer storage and recovery could be considered a beneficial use if the aquifer into which the water is injected is of sufficient quality that the CBM water can later be removed and used. Any such practice would be derailed on a site-specific level in a Water Management Plan.

C-55: If any beneficial uses are allowed, will the developer be required to obtain a water right?

R-55: Developers would not be required to obtain beneficial uses. Landowners who intend to beneficially use the water outside of the limits established by mitigation agreements and the General Discharge Permits beneficial uses may have to acquire water rights.

C-56: Will CBM-produced water that must be put to beneficial use under Montana law 85-2-521, have to meet the criteria that is in Montana law 85-2-311?

R-56: Yes. According to Montana Code Annotated 85-2-521, "Groundwater produced in association with a coal bed methane well must be managed in any of the following ways: (a) used as irrigation or stock water or for other beneficial uses in compliance with Title 85, chapter 2, part 3."

C-57: Explain the Montana Water Use Act requirements for a beneficial use permit.

R-57: See ***R-56***.

C-58: Where are the water quality standards?

R-58: The MDEQ is currently working to establish TMDLs. The Hydrology Appendix includes a discussion of the TMDL schedule for the CBM emphasis area in Montana. Chapter 2 also lists other relevant regulations that must be met, including various water quality standards. The Montana Board of Environmental Review is considering numerical standards for EC and SAR. The range of proposed standards is described in the Hydrological Resources section of Chapter 4.

C-59: Why not urge MDEQ to adopt numeric standards for assessing water quality, rather than narrative standards?

R-59: The MDEQ has asked the Board of Environmental Review to consider establishing numerical standards for EC and SAR. Formal rulemaking has been initiated.

C-60: What is the quality of produced water? Will it vary greatly from site to site or will it all be similar to CX Ranch?

R-60: It is expected that the quality of CBM-produced water will change across the Powder River Basin. Based on CBM water quality data from Wyoming, the CBM water from the rest of the basin is not expected to be significantly lower in quality than the water from CX Ranch. It may even be higher in quality. The quality of produced water is discussed under the Assumptions topic in the Hydrological Resources section of Chapter 4. The available data regarding the quality of produced water is discussed in more detail in the Water Resources Technical Report (ALL 2001b).

C-61: What methods of monitoring and enforcement will guarantee our irrigators will still be in business 5 years, 10 years, or 20 years down the road?

R-61: Water quality standards would be enforced either through permits or direct Water Quality Act enforcement. Methods of monitoring are discussed in the Monitoring Appendix.

C-62: How will the water quality and water supply of different targeted areas be assured?

R-62: The MDEQ has taken a no degradation approach to CBM development to protect water quality for all areas of development. Water supplies are assured through the designation of a Controlled Groundwater Area, as summarized in the Hydrology Appendix and presented in detail in Appendix E of the Water Resources Technical Report (ALL 2001b).

C-63: Why are there no standards based on the reduction of and the destruction of river plants, crops, aquatic life?

R-63: MDEQ is developing water quality standards for drainages of the Powder River Basin. These standards consider effects on plant life.

C-64: What is the definition of "no degradation"? Does this require that an infinitesimal impact can be extracted or measurement from monitoring data? How is the impact to be characterized?

R-64: "No degradation" as defined by MDEQ means no impacts that would prevent the beneficial use of surface waters. Where there are narrative standards, a calculation will determine non-degradation. Monitoring as described in the Monitoring Appendix will be used to characterize levels of impact.

C-65: What parameters (physical, biological, etc.) are to be used to specifically indicated impact from CBM operations?

R-65: The Monitoring Appendix includes a list of all parameters that would be monitored to evaluate impacts from CBM operations.

C-66: The DEIS should specify water quality parameters that will be monitored, who will conduct the sampling and monitoring, and what actions will be taken if constituents reach levels potentially harmful to fish and wildlife.

R-66: The Monitoring Appendix includes a list of all parameters that would be monitored to evaluate impacts and what information warrants a decision change.

C-67: Will the Montana law that provides the state citizens the right to a clean and healthful environment be upheld?

R-67: The activities associated with CBM development would be required to meet all existing laws as detailed in Chapter 2.

C-68: The EIS states in the conclusion for Alternative E that Alternative E will have the same impacts as Alternative C. Will the limits listed in the Hydrological Resources section of Chapter 4 also apply to Alternative E? In Chapter 4, Alternative C section, it refers to "High-quality watersheds." Explain how high quality waters could be degraded to assimilate CBM discharges under the Montana Water Quality Act Nondegradation policy and Montana Constitution. In Chapter 4, Conclusion of Alternative A: will the agencies allow illegal flow increases in the rivers in violation of the nondegradation law?

R-68: High quality and low quality watersheds are defined in the Assumptions for the Hydrological Resources section in Chapter 2. The MDEQ is developing TMDLs to address the issue of degradation resulting from CBM discharge (see the Hydrology Appendix).

C-69: How is infiltrated water going to be measured and accounted for in setting standards for SAR in rivers and streams?

R-69: The infiltration of produced water and eventual discharge into surface streams would be a site-specific condition identified in the Water Management Plan and would require a discharge permit. The monitoring of impoundments is presented in the Monitoring Appendix.

C-70: In the Chapter 4 Hydrological Resources section under Assumptions, it states: "It is assumed that the sodium content … is the target contaminant…" The water produced with the coal bed natural gas is not contaminated by the production process.

R-70: Agreed. See text changes in the Hydrological Resources section of Chapter 4.

C-71: How will the water quality of CBM-produced water change as it flows overland?

R-71: Based on preliminary studies by the BLM in Wyoming, it appears to be generally true that the EC of discharged CBM water will increase and the SAR will decrease as it flows over land. The changes to CBM-produced water as it flows over land would be site-specific and the analysis of this would be included in EAs for site-specific impacts on areas that include this as an option in the Water Management Plan.

C-72: Where are the draft numeric standards being proposed by Montana and the Northern Cheyenne?

R-72: The draft numeric standards proposed by the State and the Northern Cheyenne Tribe are in the Hydrology Appendix.

C-73: Construction of CBM storage reservoirs on side channels of intermittent streams may interfere with normal flows of rainfall and snowmelt and create water rights issues.

R-73: Siting criteria for impoundments are described in the Hydrology Appendix under the General Discharge Permit discussion.

C-74: There will be enormous amounts of water demanding impossibly large or numerous storage facilities. What will happen to all this stored, unusable water over the years?

R-74: Discussion of the fate of impounded water is detailed in the Hydrological Resources section of Chapter 4.

C-75: How much of the stored water will reach streams?

R-75:* See *R-69. The amount of leakage that reaches streams will depend upon the site-specific stratigraphy. These impoundments will be designed and monitored to ensure that produced waters recharge aquifers rather than discharging to streams.

C-76: Who will monitor impoundments, and what will be monitored at them? If they are found to be leaking what will be done?

R-76: Monitoring requirements for impoundments are described in the Monitoring Appendix.

C-77: How will the sites of impoundments be reclaimed after some 20 years of use?

R-77: Reclamation requirements for impoundments are described in the Hydrology Appendix under the General Discharge Permit discussion and in Chapter 2.

C-78: Impoundments of water can be a livestock trap in the winter if of sufficient depth. In some cases, they would need to be fenced and a tank installed at the toe of the dike in order for livestock to drink safely.

R-78: The construction of impoundments in areas with active livestock grazing would be included in EAs to analyze site-specific impacts if this approach were selected as an option in the Water Management Plan.

C-79: Designation of a holding pond should be left to the discretion of the operator.

R-79: The construction of impoundments would be addressed in a Water Management Plan that should include a proposed process for reaching agreement with the surface owner regarding the location of the impoundment prior to construction. The design and placement of impoundments must also meet all necessary regulatory authority.

C-80: Will the holding ponds be required to be lined?

R-80: The construction and design of impoundments would depend on site-specific conditions that would be detailed in a Water Management Plan. The impoundments would be required to meet all necessary regulatory authority.

C-81: Evaporation will leave an even saltier body of water.

R-81: Agree. The evaporation of water from storage ponds would result in an increased TDS concentration in the water that remains in the pond. See the General Discharge Permit in the Hydrology Appendix for a description of actions when pond water is concentrated.

C-82: The Wyoming DEIS states these ponds act as flood control. How can it be flood control and not affect water righted water?

R-82: Impoundments covered by the Montana General Discharge Permit in the Hydrology Appendix would be restricted to off-drainage areas. These impoundments would not be built for flood control.

C-83: Will impoundments trap runoff water in violation of downstream water rights?

R-83: See ***R-82***.

C-84: Site-specific surface and geological factors and water quality parameters need to be taken into consideration before infiltration-restrictive techniques are recommended.

R-84: Agree. Site-specific conditions would be specified in the Water Management plans that must be approved prior to constructing any impoundments. In addition, site-specific EAs would analyze the potential for impacts from infiltration, and restrictions could be placed to prevent these impacts prior to pond construction.

C-85: What criteria will be used for the construction of impoundments?

R-85: The size of impoundments would be dependent on site-specific data. The site-specific Water Management

Plans and EAs would provide all necessary data prior to construction of the impoundments.

C-86: "Water released to unlined surface impoundments has the opportunity to infiltrate into shallow aquifers, causing measured impacts on the depth to water in the alluvial aquifers and alluvial wells." There is not any supporting data for this statement.

R-86: The extent of infiltration and the impacts on alluvial aquifers would be dependent on site-specific conditions. In areas where shallow alluvial aquifers exist and unlined impoundments are constructed above the aquifers, the potential exists for infiltration of water into the alluvial aquifers. See reworded text in Chapter 4 in the Hydrological Resources section.

C-87: In Wyoming, they are drilling holes in the bottom of the pond to shallow aquifers to allow the water to infiltrate. Would Montana ponds be used for this type of activity?

R-87: Drilling holes to facilitate infiltration would only occur as a site-specific condition. Prior to actual drilling, the activity would be analyzed in a site-specific EA and detailed in a site-specific Water Management Plan. This activity may also require additional permits, such as injection permits.

C-88: "Surface storage of produced waters would also require an MPDES permit issued by MDEQ." This statement is misleading because authorization to discharge under a general permit is different than having to obtain an individual MPDES permit.

R-88: See revised text under Alternative E—Preferred Alternative section of Chapter 2.

C-89: What is the source of surface impoundment BMPs?

R-89: BMPs are developed from a variety of sources. Some are developed from regulatory and agency experience, others are developed from operator experience in other regions with CBM production.

C-90: Why is treatment of CBM-produced water not required for all alternatives that involve the discharge to surface waters?

R-90: Due to the variable nature of the produced water quality, treatment is not required for all the produced waters that may be disposed.

C-91: What method of treatment would be used to improve the quality of produced water prior to discharge. Is there a method of treatment that would reduce the SAR to acceptable levels?

R-91: Many treatment methods are available to treat high SAR waters. CBM producers will use the technology that best fits their needs.

C-92: There needs to be a discussion of the economic feasibility of water treatment.

R-92: The use of water treatment will be included in the Water Management Plans. If the quality of produced water is questionable, operators will need to evaluate the feasibility of using treatment to handle the water.

C-93: We have a well/spring and are concerned that the withdrawal of groundwater during the production of CBM may contaminate our well or dry up our well/spring. If our well/spring is impacted how will we be compensated? Who will pay for the mitigation?

R-93: Under both the DNRC Final Order Designation of the Powder River Basin-Controlled Groundwater Area and the MBOGC Board Order 99-99, each CBM operator must extend a water mitigation agreement to owners of water wells or natural springs within 0.5 mile of a proposed CBM field. The area will be automatically extended 0.5 mile beyond each impacted well or spring. The mitigation agreement must provide for prompt replacement of water affected by CBM development. The presence of mitigation agreements will be considered in the review of development applications by operators.

C-94: What information will be included in the Water Mitigation Agreements?

R-94: Water mitigation agreements will include area of proposed development, area under the mitigation agreement, locations of existing water wells and springs, possible sources of replacement water, and reasons for exclusion, such as mechanical and electrical problems.

C-95: What information/requirements will be included in the Water Management Plans and what agency is responsible for their approval?

R-95: The Water Management Plans will address site-specific conditions, as well as water management practices and their effects on soil, water, vegetation, wildlife, and groundwater depletion. Depending on the details of the Water Management Plan, the MDEQ, MBOGC, DNRC, BLM, or EPA would be responsible for its approval. Also see response to **C-47.**

C-96: If water basins are already over-appropriated, how can any new water rights or beneficial uses be justified?

R-96: The produced water will be allowed by statute and many of the beneficial uses can replace water allocated from surface water sources.

C-97: A stipulation is needed that prohibits CBM wells within some radius of inventoried groundwater resources.

R-97: Groundwater resources will be managed through the use of Water Management Plans, the requirements of the DNRC Final Order Designation of the Powder River Basin controlled Groundwater Area, and the MBOGC Board Order 99-99.

C-98: The DEIS does not address water discharge concerns or water table depletion specific to areas other than the Powder River Basin.

R-98: The Powder River Basin is expected to have the largest impact from CBM production. Impacts on the Powder River Basin can be extrapolated to other areas to determine the potential impacts from CBM production in those areas.

C-99: Why does the DEIS assume impacts on the Bozeman Pass and Hanging Woman areas; Stillwater, Big Horn, Gallatin, and Park counties; and Yellowstone River and Rosebud Creek would be the same as for the rest of the Powder River Basin?

R-99: Impacts from CBM activities will be similar because of the nature of the production activities, however the magnitude of these activities is expected to be substantially more in the Powder River Basin (PRB) than in other regions of the state. The RFD provides the production estimates used for this assessment. The Groundwater quality will also be chemically different from PRB groundwaters, but would still be handled through the use of a Water Management Plan.".

C-100: The values presented in the Montana DEIS for SAR and EC of the CBM-produced water are significantly different than the values in the Wyoming DEIS.

R-100: The SAR and EC values used in the EIS were gathered from information from the CX Ranch and CBM production in Wyoming. These assumptions have been modified to reflect data from the Wyoming portion of the Powder River Basin. For a complete description of these assumptions, see the Assumptions section of the SWQATR.

C-101: What accounts for these differences? Are there differences in the water quality within the Powder River Basin between the two states?

R-101: Water quality within the Powder River Basin is highly variable, and the exact quality of the locally produced water is unknown until actual production wells are drilled and the water sampled.

C-102: The DEIS addresses drawdown up to 50 percent in some areas and production rates from the coal seam aquifers but does not include recharge rates. How long will it take for the aquifers to recharge and how are the confined coal seams recharged?

R-102: The 3D groundwater model prepared by the MBMG (Wheaton and Metesh, 2002) in conjunction with this EIS predicts that produced coal seams will recover at least 70% of their hydrostatic pressure within 5 to 12 years. Outside the field, productive coals should regain 90% of their pressure within 3-5 years. Nonproductive coal seams would recover 80% of their reservoir pressure within 5 years. The groundwater modeling conducted in conjunction with the current Wyoming CBM EIS also indicates that recovery of coal seams to within 20-30 feet of pre-production levels will require 3-4 years after the completion of production. The final recovery of the aquifers to pre-production levels will be a long-term process possibly requiring hundreds of years.

C-103: Restoration of the hydrologic balance is not addressed.

R-103: The recovery of the aquifers is discussed in Chapter 4 in the Hydrological Resources section.

C-104: What fraction of this rebound is actual recharge and what fraction merely represents an increase in the radius of the cone of depression? What process protects the existing groundwater users outside the immediate area of a field from this probable loss or reduction in their water resource?

R-104: Some of the recovery will be an enlarging of the cone of influence from production, but it is not expected to impact areas more than 14 miles away. The Water Management Plans required from CBM operators will address water production issues.

C-105: In a state where water rights are protected and water use permits are issued, how can the production of groundwater associated with CBM be allowed?

R-105: Exemption for CBM wells up to 35 gpm is established in the Final Order of the Montana DNRC, "In the Matter of the Designation of the Powder River Basin Controlled Groundwater Area." This is included in Appendix E of the Water Resources Technical Report.

C-106: How can operators divert or impound water that is protected by water rights?

R-106: The current policy of the MDEQ, as demonstrated in the attached General Discharge Permit for CBM Produced Water (See Hydrology Appendix), is that "Impoundments constructed for the purposes of holding and storing produced water from CBM development must not be located in ephemeral, intermittent, or perennial drainages…". As such surface impoundments will not divert of impound water that is protected by water right

C-107: The DEIS fails to identify that CBM wells in the State are not presently required to obtain a water right.

R-107: See ***R-105***.

C-108: How will CBM production in Wyoming impact the waterways (Powder, Little Powder, and Tongue rivers) that cross into Montana?

R-108: Anticipated impacts to surface waters due to Wyoming CBM production are addressed in the Surface Water Quality Analysis Technical Report (SWQATR). This analysis is also summarized in Chapter 4 of this EIS. This surface water analysis was prepared in conjunction with Wyoming to ensure that the cumulative impacts of CBM production in both states were adequately addressed. Montana hopes to limit the impacts from Wyoming CBM production on Montana through a cooperative agreement between Wyoming and Montana.

C-109: Water quality in shared waterways needs to be monitored.

R-109: We agree with this statement. Please see the Monitoring Appendix Table, under Hydrology, Surface water quality and quantity for further details.

C-110: The DEIS includes a brief discussion of the interim agreement between the WY DEQ and MT DEQ. Will this agreement be renewed and will there be any changes to the agreement?

R-110: The final outcome of the cooperative agreement between Wyoming and Montana is outside the scope of the EIS. However, any Montana water quality standard that is approved by the US EPA would have Clean Water Act standing, and as such would need to be met at the border.

C-111: How will groundwater and surface water impacts from CBM production and discharge be monitored?

R-111: Impacts on surface water and groundwater will be monitored through the use of Water Management Plans and MPDES permit requirements. Specific monitoring requirements are addressed in the Monitoring Appendix.

C-112: Who will perform the monitoring, will the state and federal agencies do the monitoring, will it be operators?

R-112: Both operators and state and federal agencies depending on the location and type of CBM production activity will conduct impact monitoring.

C-113: Who will pay the costs associated with this monitoring? Will it be the developers and relevant agencies, or citizens?

R-113: The cost of monitoring will be the responsibility of the operator or agency, depending on the reasons for the monitoring activity.

C-114: What will happen if CBM companies are found to have leaking reservoirs, discharges, etc. that enter surface waters? Will they be fined? Will production stop?

R-114: The response by state and federal agencies to leaking reservoirs or discharges outside of permitted activities will be handled as allowed under the rules for the specific state or federal agency. See the General Discharge Permit for CBM Produced Water in the Hydrology Appendix, section III for current punishments for non-compliance with that permits.

C-115: The Montana Powder River Basin area is an arid climate which is currently experiencing a prolonged drought. Will the production of groundwater associated with CBM exacerbate this problem?

R-115: The production of groundwater from the coal seams may help the drought problem by providing a source for livestock water and irrigation water depending on the quality of the produced water.

C-116: Methane-producing coals contain gas only because they are separated from shallower coals.

R-116: Coal bed seams that produce methane contain a sufficient head of water to maintain pressure in the coal seam, causing methane to adhere to surfaces of the coal. Nonproductive coals do not have sufficient water pressure and methane has escaped to the atmosphere.

C-117: The DEIS states that the coal seam aquifers where CBM will be produced are confined in nature. What evidence supports this statement?

R-117: Coal seam aquifers are thoroughly discussed by the MBMG in its modeling report (Wheaton and Metesh 2002).

C-118: Are the aquifers hydrologically separated from the overlying aquifers?

R-118: The coal aquifers are generally hydrologically isolated from the aquifers above and below them. This is discussed in some detail in the MBMG 3D Groundwater Modeling Report prepared in conjunction with this EIS (Wheaton and Metesh, 2002). Coal seams appear to be confined because their static water levels come to rest above their upper contact (i.e. they are artesian). Field data collected in association with the ongoing installation of CBM monitoring wells also supports the idea that the coal seams are isolated. In particular, despite bedrock being saturated within tens of feet of surface, static groundwater levels in the deeper coals are far beneath ground surface, yet above the top of the coal. Detailed quantitative analysis of vertical leakage (or vertical hydrologic conductivity, K_z) is planned to be conducted in conjunction with the hydrologic testing of the monitoring wells, which have been installed in nests (or clusters) so that water levels in the coal aquifer, and in the sand aquifers adjacent to them, can be monitored while water is pumped from the coal bed aquifer.

C-119: It is unrealistic to estimate the amount of water use over 20 years. Extremely high volumes are used in the first years of production—it tapers off after 5 to 10 years but the damage to the aquifers is already done.

R-119: We agree that water production is time-dependent. The highest production rates occur in the first months of production and then fall off. This relationship of production rate to time is discussed in the Water Resources Technical Report (ALL 2001b), and we have used it to predict possible discharge volumes and surface water impacts. Predicting impacts on groundwater requires knowledge of the total volume to be pumped, as well as the peak rates of withdrawal. The peak withdrawal rate is a function of rate of production per well and the number of completed wells. It is also important to remember that water levels in the coal seam aquifers will recover a large percentage of their drawdown within a few years after CBM production has ceased.

C-120: The 2.5 gallons per minute (gpm) average rate is an assumption and no firm data has yet been produced to substantiate this number.

R-120: The 2.5 gpm is a 20-year average production rate. This figure is based on a decline curve analysis of all CBM wells in Montana, as discussed in the Hydrology Resources section of Chapter 4. Initial rates of water production are expected to be much higher (approximately 15 gpm or more), while water production in the final years of production is expected to be near zero. For determining surface water impacts, the maximum total discharge rate is expected during year 6 at 6.2 gpm with 12,641 wells pumping at that time. Additional information about the calculation of production rate versus time is available in the Hydrology Resources section of Chapter 4, in the Hydrology Appendix, and in the Water Resources Technical Report (ALL 2001b) , and in the Surface Water Quality Analysis Technical Report (Graystone and ALL, 2002).

C-121: Why do the estimated rates of water production differ so much from the 12.5 gpm discharge in the Wyoming Powder River Basin EIS?

R-121: The Wyoming EIS used estimates from the early production life of the wells in the state and did not account for the reduction in production rate over time. Coordination Wyoming and Montana during the preparation of the Surface Water Quality Analysis Technical Report (Graystone and ALL, 2002) has resulted in Wyoming adjusting this value to 6.2 gpm for the time of maximum production, which matches the value used by Montana.

C-122: Why weren't water production rates from the test wells completed in Montana included in the EIS?

R-122: The water production rates from coal seam test wells were not included in the decline curve analysis because long-term production data was not available and a long-term decline could not be calculated.

C-123: In Chapter 4 of the DEIS, the Hydrological Resources section under Assumptions states that the CBM discharge rate is 2.5 gpm per well (single well, 20-year average). In the paper "Water Quality Technical Report" published December 18, 2001, by MDEQ, a graph on page 27 shows that the average CBM will discharge starting at about 15 gpm and take 10 years to reduce down to 2.5 gpm. Is it realistic to base your assumptions about water on this lower amount?

R-123: As long as the 2.5 gpm is kept in context as a 20-year average, it is reasonable to use this number. However it must be recognized that production rates for a single well will be much higher initially and will taper off to near zero in the final years of production.

C-124: EPA's calculated average well production rates are approximately double the values used in the Montana DEIS and range from 4 to 6 gpm/well, depending on the watershed. If a shorter well life span (10 years) and shorter development plan life span (20 years) are coupled with exponentially decreasing rates of production for individual wells initially discharging at 15 gpm, the following average production rates are obtained (Figure I, page 14, of the comments submitted by EPA). The 20-year cumulative average is lower (1.8 gpm/well as compared to 2.9 gpm/well), but the 10-year cumulative average is higher (3.2 gpm/well as opposed to 2.9 gpm/well). EPA recommends that a value of approximately 4 gpm/well should be used in the Tongue River watershed, 5 gpm/well in the Powder River watersheds, and 6 gpm/well in the Little Powder River watersheds.

R-124: In response to the EPA analysis the states of Montana and Wyoming, in conjunction with the EPA, determined that the most accurate analysis of impacts would be achieved by basing surface water impact analyses on the maximum production rate that is predicted to occur for the Powder River Basin. This peak production is predicted to occur in year 6 of the RFD. During year 6 Montana and Wyoming wells are predicted to produce water at a total field average rate of 6.2 gpm. This value is now used in the analysis of impacts to surface waters.

C-125: How will the DEIS be in full compliance with the Clean Water Act and Montana Water Quality regulations, including not impacting beneficial uses and being in compliance with TMDLs? Will the discharge of poor quality, high sodium water be monitored or held to Montana's water quality standards? Does the State consider them to be discharges?

R-125: All discharges to a water body will be monitored under the MPDES permit system and will meet all requirements of the Montana Water Quality Act, and the Clean Water Act.

C-126: The DEIS states that large volumes of water will be removed from the [coal] aquifers in the basin and that recharge to aquifers could take as much as hundreds of years to recover. What are the long-term impacts of the withdrawal of water from the coal aquifers and how will it affect the regional hydrology?

R-126: The long-term impact on regional hydrology will be a reduction in the water table that will take years to recover. Local springs and some surface water flow will be reduced until complete recovery is obtained. Further discussion of these impacts is included in the Hydrological Resources section of Chapter 4.

C-127: What is the total volume of produced water from conventional oil and gas development? What is the average water quality and what percentage is treated? What percentage is discharged to surface water and what percentage is injected?

R-127: A small portion of produced water from conventional oil and gas production is discharged to the surface. Water produced from typical oil and gas production is considerably higher in TDS than water produced from CBM. Information on the volumes of produced water from conventional oil and gas can be obtained from the MBOGC.

C-128: The NPRC produced a document called "Doing It Right" which recommends development that includes aquifer recharge, clustered development, active enforcement of existing laws, including the Clean Water Act, multiple wells drilled directionally or horizontally from fewer, clustered pads and other best-available technologies to minimize and avoid impacts. Why was this not analyzed as an alternative?

R-128: This information was reviewed in preparing the DEIS and considered during the development of alternatives. The DEIS addresses the management of CBM development and cannot specify how CBM operators will develop specific fields. Each CBM field is different, and variations on completions and well spacing must be made to develop each field.

C-129: In Chapter 4, under the Preferred Alternative, it states a Water Management Plan must be developed explaining how an operator can discharge CBM water without degrading our surface water before discharge can occur. Has this been done? If not, it must be completed before the 90-day public comment is over.

R-129: This requirement is for each individual operator to complete once they have applied for a CBM development permit. These site-specific Water Management Plans will be prepared and submitted to the state and BLM for review prior to the issuance of drilling permits. These water plans are not part of this EIS.

C-130: There is a theory that the water at the bottom of an aquifer is of lesser quality than the water at the top of an aquifer when the aquifer is first tapped. If this is true, the water that will be left in the coal seams at the end of the 20-year life of proposed CBM wells may be poorer quality to a greater or lesser extent than the water that landowners are currently using. What kind of quality do you predict to remain in the leased areas after the CBM is gone? Will it relate to the chemical analysis and quality of the coal?

R-130: The final water quality of the coal seam aquifers is dependent on the formations through which the groundwater infiltrates to recharge the aquifer. At the end of production, the water quality could potentially be less than when production started, but this is highly dependent on the specific reservoir characteristics.

C-131: The Chapter 4 section on Impacts From Management Common to All Alternatives of the DEIS states that the drawdown level could extend up to 14 miles from the edge of production. If this is the case, why isn't the circle of influence for impacted water wells not at least 14 miles? Doesn't current Montana law require "replacement" water only a mile from CBM wells?

R-131: The establishment of the Powder River Basin Controlled Groundwater Area requires that once a well or spring is impacted, mitigation agreements will be required to be offered an additional 0.5 miles out from the impacted well or spring. In this way mitigation agreements should stay ahead of impacts.

C-132: In Chapter 4, Assumptions Common to All Alternatives, in the section dealing with General Assumptions, the EIS states that approximately 8,000 gallons of water would be needed to drill each well. Will this water be obtained without water right?

R-132: How the CBM operator obtains the water for drilling is not within the scope of the EIS.

C-133: Can produced water from nearby CBM wells be used beneficially to drill additional CBM wells?

R-133: Yes. CBM water can be used to beneficially drill additional CBM and conventional oil and gas wells.

C-134: Will the FEIS specify that the Tongue River drainage cannot be used for drilling water? Do the other rivers also have the same designation as the Tongue River?

R-134: The EIS does not specify the water rights for any rivers. The control of water rights is not within the scope of the EIS.

C-135: Why are discharge permits still being issued? Why aren't SAR and bicarbonate levels being monitored?

R-135: Currently no new discharge permits are being issued for CBM development because of the current moratorium on development. The MPDES program will be responsible for issuance and monitoring of discharges from future development. The existing discharge to the Tongue River is being monitored according to the requirements of the MPDES permit. In addition, the USGS continues to monitor water quality at its established stations. Parameters such as bicarbonate and SAR are routinely measured and published as part of its monitoring program.

C-136: Will the Tongue River Reservoir act as a settling pond for the minerals and salts in the produced water and will this water be the first water to be discharged for irrigation? What effect will this have on the Tongue River Reservoir after 20 years of CBM development?

R-136: Use of the Tongue River Reservoir will not be altered by CBM development. The actual flow of the river may be increased due to permitted discharges. The chemistry of the water leaving the reservoir will reflect the long-term chemistry of the water entering the reservoir. Therefore, as long as the water flowing into the reservoir meets the beneficial use criteria, the water flowing out also will meet the criteria. The density of CBM water is not sufficiently different from the existing water to cause it to stratify. Therefore, complete mixing of all waters flowing into the reservoir should occur.

C-137: What will happen when water sources are no longer available for stock water or other beneficial uses because the groundwater is depleted? How will these beneficial uses be protected in the future?

R-137: Water Management Plans and Water Mitigation Agreements will detail, on a site-specific basis, the responsibilities of operators once production ends.

C-138: There is a passing reference to chloride and barium in Chapter 4, Impacts from Management Specific to Each Alternative for Alternative A, in the Conclusion that states, "Water quality parameters other than SAR would be impacted similarly to SAR, including chloride and barium, which can also result in both direct and indirect environmental impacts." What does that mean? What about magnesium? Can we expect increased levels of magnesium sulfate in livestock water as a result of CBM water? What effect will this have on livestock drinking the CBM water? What about selenium? What about the concentration of selenium in plants of the Astragalus genus?

R-138: Water quality impacts will be determined by the composition of produced water. Individual constituents such as magnesium and barium could be an issue depending on the analysis of produced water. Discharge of produced water will be limited by the MPDES program to minimize the impact on surface water bodies. Under the MPDES permit system all beneficial uses will be protected. Livestock and plant information is contained in other sections of the FEIS.

C-139: What about the sulfate ion interfering with the take up and utilization of copper in cattle? Will livestock producers be required to resort to copper injections due to increased levels of sulfate in the water?

R-139: See ***R-138***. Water discharge will be in accordance with MPDES permits, which will be written with regard to site-specific water quality and beneficial uses.

C-140: I am interested in the final EIS presenting the aquifer depths that are showing quicker than expected depletion.

R-140: CBM production characteristics in other U.S. basins is beyond the scope of this EIS.

C-141: Was this depletion similarly experienced in the San Juan, Green River and other areas that have had CBM exploitation in the past?

R-141: CBM production characteristics in other U.S. basins is beyond the scope of this EIS, however the pumping of groundwater is fundamentally required to release the CBM from the coal surfaces.

C-142: In the Chapter 4 Hydrological Resources section under Assumptions, the assumption is that the quality of CBM-produced groundwater throughout the planning area is the same as the quality of CBM-produced groundwater at the CX Ranch field. The EIS does not justify this assumption.

R-142: This assumption has been changed for the FEIS. As shown in the Hydrological Resources section of Chapter 4, CBM water quality data from both Montana and Wyoming are used to provide a reasonable range of possible CBM water qualities for different portions of the Powder River Basin.

C-143: Table 3-3 (DEIS Chapter 3): The average base flow is given. When was the data taken and how many years were the average based on?

R-143: The data was obtained from the USGS and the calculations were conducted by the USGS in its report.

C-144: In Chapter 3 Private Landowner Revenue section under Water Resource Values: The EIS states that most of the water in the planning area originates as groundwater. This is not true. The majority of the Tongue River Water originates from rainfall and snowmelt.

R-144: We agree, volumetrically the majority of surface water in the Powder River Basin is derived from precipitation and snowmelt.

C-145: Agencies make the assumption that operators will need one impoundment for every 20 wells with each impoundment 5-6 acres in size. No data, information, or rationale is given to support this assumption.

R-145: As stated in Chapter 4 under Assumptions Common to All Alternatives, the values were determined from a variety of sources, including previous CBM EIS documents and discussions with BLM, state, and CBM operation personnel.

C-146: Why does the EIS not discuss the use of more current technology to reduce impacts on water depletion?

R-146: CBM operators are using the latest technology available to reduce the amount of water pumping required for methane production in an effort to reduce the cost of pumping water to the surface.

C-147: How are CBM wells constructed so that the withdrawal of water from overlying aquifers does not occur?

R-147: CBM wells are constructed with cemented casing set at the top of the coal formation. The cement provides a seal to minimize the production of water from upper aquifers.

C-148: Where are the baseline studies and inventories for groundwater aquifers, springs, seeps, including inventories of abandoned oil, gas, and water wells, Yellowstone River water quality and quantity, and other watersheds, wildlife, and vegetation? Will these studies be completed by the time of the FEIS?

R-148: Baseline information, studies, and water quality information are included in the EIS. This information was gleaned from existing information available from public sources. Additional studies are planned. However, under NEPA, an EIS must be prepared using “best available data.”

C-149: The EIS should include studies of the hydrogeologic characteristics of the aquifers that overlie the coal seam aquifers.

R-149: The EIS is a statewide document and is not intended to study the impacts on each individual aquifer. CBM operators will be required to discuss impacts on aquifers within their Water Management Plans.

C-150: Will groundwater under tribal lands be subject to remediation agreements?

R-150: Water mitigation agreements as described in Chapter 6 of the Water Resources Technical Report also cover tribal lands.

C-151: CBM development should not be allowed on the reservations.

R-151: The development of CBM on tribal mineral rights is outside the scope of this document.

C-152: Chapter 4 Geology and Minerals for Alternative E in section for the Crow Reservation: Expand upon “hydrologic barrier.”

R-152: The exact engineering of the hydrologic barrier will depend on the operator for localized specifications.

It will consist of producing wells and injection wells to manipulate water movement within the coal seam.

C-153: The EIS states that the Northern Cheyenne hold a water right in the Tongue River and that it is marketable and sensitive to water quality changes; the same is true for the Tribe's holdings in the Big Horn River and this is not mentioned.

R-153: The Northern Cheyenne-Montana Compact establishes a water right for the tribe that covers water from the Tongue and Bighorn rivers and Rosebud Creek. See amended wording in Chapter 3 under the Native Americans section.

C-154: The Northern Cheyenne Water Compact with the State and the Federal government discusses groundwater drainage under the reservation. Will the aspects of this compact be analyzed in this EIS?

R-154: See changes to text in Chapter 4.

C-155: In the Chapter 4 Hydrological Resources section for Impacts from Management Specific to Each Alternative for Alternative A in the Crow Reservation subsection, it states: "The Crow Reservation can expect few impacts from CBM development within Montana under this alternative." Yet three sentences later admits that 14-mile drawdowns "could impact water wells and springs on tribal lands." The next paragraph states, "CBM development in Montana and Wyoming could drain groundwater and methane from coal seams under the reservation."

R-155: Under Alternative A, only current CBM development at CX Ranch will be allowed. This development is geographically distant from water wells on the reservation and impacts are likely to be slight. Under this same Alternative, Wyoming CBM development will continue to grow. This level of development could impact reservation water wells.

C-156: The EIS and Water Resources Technical Report reference a 2-dimensional and 3-dimensional model of CBM impacts on groundwater resources. Where is the information regarding these models and where are the results? Were these models used to quantify aquifer recharge and recovery rates?

R-156: See text in the Hydrological Resources section of Chapter 4 that includes a discussion of modeling. The complete reports are available directly from MBMG, either through their web site at http://www.mbmg.mtech.edu or via telephone at (406) 496-4167.

C-157: The production of CBM in proximity to coal mines severely limits the coal mining regulatory authority's ability to determine how coal mining is affecting the hydrologic resources.

R-157: CBM production near existing or new coal mines may affect the groundwater elevation in the mine and will limit the determination the coal mine's effect on water resources.

C-158: How will the CBM affects be monitored so that they can be differentiated from coal mining effects?

R-158: The CBM operator will need to address the impact on water resources in the Water Management Plan.

C-159: Does the EIS address the cumulative affects to drawdown resulting from CBM production and coal mining?

R-159: The EIS addresses the cumulative impacts from all activities in the discussion for each alternative in Chapter 4.

C-160: The EIS does not adequately address the impact of freezing temperatures on infiltration basins or direct discharge (land spreading).

R-160: Freezing temperatures will limit the volume of water discharged. Individual operators will need to manage changes from weather.

C-161: What are the environmental consequences of prolonged freezing and frost depth and how will freezing affect water quality?

R-161: The freezing of CBM water is not expected to alter its overall chemistry. Therefore prolonged freezing is not anticipated to cause any environmental impacts. Frost depth may alter water infiltration rates in water spreading operations, which would reduce the volume of water that could be managed by such an operation during winter months. These effects would need to be addressed in site specific Water Management Plans.

C-162: What impacts will North Dakota experience?

R-162: Effects of CBM development in Montana on North Dakota are expected to be quite slight. The surface water quality of the Yellowstone River, which flows into North Dakota, would be slightly altered as outlined in the Hydrological Resources section of Chapter 4. The resultant water quality at the Sidney, MT USGS station on the Yellowstone is expected to be quite similar to the water quality that would flow into North Dakota. All discharges to state waters, and the state waters themselves, will be monitored through the MPDES permitting program to ensure that beneficial uses are not impacted.

C-163: The EIS does not address subsidence. Will the removal of groundwater from the coal seams result in ground subsidence?

R-163: Ground subsidence resulting from groundwater removal should not be an issue in the areas of CBM production because of the thick layers of sedimentary rock located above the zones of potential production.

C-164: In Chapter 2 under the section Management Actions Specific to Each Alternative, Alternative A, it states, "Discharges from CX field would be to Tongue River through MPDES permit." What about discharges to impoundments? What about use of water at coal mines?

R-164: The options for water management under Alternative A are presented in Chapter 2.

C-165: In Chapter 4 under the Impacts from Management Specific to Each Alternative, Alternative A, it states, "CBM activities would not result in additional impacts on surface water or groundwater." Identify existing impacts.

R-165: Existing conditions are described in Chapter 3.

C-166: Chapter 4 under the Aquatic Resources section states, "Management features contained in Alternative E, including the overall Project Plan and Water Management Plan, would mitigate or minimize numerous potential impacts on aquatic resources including special status species, that otherwise might result from CBM development." Explain how these plans will mitigate impacts.

R-166: Project Plans and Water Management Plans will detail the operator's plan to develop and manage produced water, and will include BMPs. The regulatory agencies would have site-specific plans for managing produced water and determining monitoring and permitting requirements.

C-167: Will the agencies provide an alternative that has no effect on irrigation and groundwater resources?

R-167: See the discussion of Alternative E (Preferred Alternative) in Chapter 4.

C-168: In Chapter 2 under Management Actions Specific to Each Alternative, Alternative C, it states, "The operator must obtain 401 Certification from the state if the disposal action needs BLM approval." This statement does not accurately reflect the requirements of the Clean Water Act Section 401 which requires the approval of any federal license or permit to obtain state certification including the BLM approval of an Application for Permit to Drill.

R-168: 401 Certification for federal actions that could result in a discharge to state waters will be required, even if the State issues a MPDES permit.

C-169: In the Chapter 4 Wildlife section under BLM, USFS, and Montana Species of Concern, it states, "As previously discussed, pumping at CBM wells during development and operation may also alter near surface hydrology by dewatering local aquifers or lowering shallow groundwater levels." Please reconcile this statement with statements in the Hydrological Resources section that dewatering activities will not impact shallow aquifers because of the presence of confining layers?

R-169: See changes to text in Chapter 4.

C-170: The Hydrological Resources section in Chapter 4 does not seem to contain mitigation components.

R-170: See text changes for mitigation measures in Hydrological Resources.

C-171: In Chapter 4, Hydrological Resources under Assumptions, in the second bullet, what is the definition of "short term"?

R-171: "Short term" refers to the initial higher water production rate of a CBM well. This higher rate duration is variable depending on site-specific conditions and on average production rates that decline sharply in the early years.

C-172: In the Chapter 4 Hydrological Resources section under Assumptions, it states that the 70 percent conveyance loss anticipated in the EIS would be applicable only if the waters travel at least 14 miles before joining a major drainageway. Clearly, water from CBM wells is likely to reach major regional rivers.

R-172: This value has been re-estimated at 20 percent for in-stream losses.

C-173: Map 3-4 of the DEIS is the Bedrock Aquifer map, but it is described here as the "portion of the planning area with the greatest potential for CBM development." Which is Map 3-4?

R-173: See changes in text in Chapter 3.

C-174: In the Chapter 4 Hydrological Resources section for Alternative B under Production, it states, "Surface water and springs should not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seam aquifers" is misleading. Regional drawdown will be observed at the margins of the coal seam aquifers, which can impact spring flow and groundwater discharge to streams. This is why Technical Advisory Committee has proposed concentrated water-level monitoring at the coal seam outcrops (Monitoring Appendix).

R-174: The regional drawdown on the margins of coal seam aquifers would not be a direct impact from CBM development. This drawdown would result as the confined aquifers attempt to reach a new equilibrium. This drawdown will be monitored as detailed in the Monitoring Appendix.

C-175: Table 4-19 Hydrological Resources (DEIS): Under Alternative E, the last bullet reads "see also Mitigation subsections described under Hydrological Resources in Chapter 4." However, mitigation is not a subheading in this section.

R-175: See changes to text in Chapter 4.

C-176: In the Introduction to the Monitoring Appendix: "Adverse impact" to a "key resource" is observed, then, "… if it can be corrected by a management action within the scope of this plan, the change will be implemented." This needs to be better spelled out. "If the adverse impact," the EIS continues, "can be corrected only by a management action that is outside the scope of this plan … the management change will be a formal amendment."

R-176: An impoundment may considerably affect local surface water by increasing EC due to infiltration of produced water. In that situation, the normal scope of the plan might call for increased rate of monitoring and reporting. Management actions beyond the scope of the plan might entail a formal amendment to require the operator to install extraction wells for modifying infiltration and protecting groundwater resources.

C-177: In the Monitoring Appendix under Indian Trust for Information Warranting a Decision Change: Please clarify the amount of drawdown in the statement "for drawdown measured beyond 2 miles.

R-177: Drawdown will be determined on a site-specific basis.

C-178: If allowed to run on the ground, were the effects of direct discharge to the ground taken into account when assessing the impacts?

R-178: The impacts of discharge to land surfaces were addressed in the Hydrological Resources section of Chapter 4.

C-179: Evidently, contaminated water moving through the soil moves in a "plume" fashion as all liquids do and there is little or no mixing. With that seepage, how long will it take for water to surface and what will the quality be at that point? Who would be responsible if the quality of that water causes problems downstream?

R-179: The mixing and dispersion of CBM-produced water that infiltrates into soils would be dependent on site-specific conditions. Infiltrated waters that seep from impoundments would be monitored as described in the Monitoring Appendix.

C-180: In the Chapter 1 section on Agency Responsibilities for the BLM concerning reservoir engineering/economic analysis, if this mapping can be done to protect hydrocarbons, why is it not required to verify and predict reservoir behavior, thereby helping to establish the best water management alternative?

R-180: This type of analysis was used for the EIS. Reservoir analysis includes drainage and production of water because it is so closely tied to CBM production. However, currently no production data is available for CBM in Montana outside of the CX Ranch field.

C-181: In the Chapter 3 Hydrological Resources introduction section, domestic uses should be added to the use of coal aquifer water in rural areas.

R-181: See changes to text in the Hydrological Resources section of Chapter 3.

C-182: In the Chapter 3 Hydrological Resources section under Surface Water in the DEIS, the Map 3-4 reference should be corrected to reflect Map 4-3, "Predicted Number of CBM Wells by Watershed for Expanded Development Scenarios Regardless of Ownership."

R-182: See changes to text in the Hydrological Resources section of Chapter 3.

C-183: In the Chapter 3 Hydrological Resources section under Groundwater, the DEIS does not identify that the 1,500 and the 2,800 are TDS. This parenthetical statement should include TDS.

R-183: See changes to text in the Hydrological Resources section of Chapter 3.

C-184: In the Chapter 4 Environmental Justice section under Impacts From Management Specific to Each Alternative for Alternative B—Groundwater Drawdown: The 21 percent appears high based on data obtained from Wyoming.

R-184: See changes to text in the Hydrological Resources section of Chapter 4.

C-185: In the Chapter 4 Environmental Justice section under Impacts From Management Specific to Each Alternative for Alternative E—Northern Cheyenne, it states, "…similar to impact projected under Alternative

E.” This text is unclear. Should it say “…similar to impacts projected for the region under Alternative E”?

R-185: See changes to text in the Hydrological Resources section of Chapter 4. Low monthly mean stream flows are now used in both EISs, and 7Q10 low flows are also analyzed in the Surface Water Quality Analysis Technical Report.

C-186: In the Chapter 4 Geology and Minerals section under Impacts From Management Specific to Each Alternative for Alternative A, it states: “Removal of groundwater by CBM wells in coal seams that are being mined by Decker and Spring Creek could reduce the amount of groundwater flowing into the mineral areas.” This statement needs to be amended to reflect that Spring Creek is a dry mine.

R-186: See changes to text in the Hydrological Resources section of Chapter 4.

C-187: In the Chapter 4 Lands and Realty section for Alternative E, under Preferred Alternative Impacts and Mitigation—Conclusion: If there is no project plan required, would the water management plan also not be required?

R-187: Under Alternative E—Preferred Alternative, Project Plans and Water Management Plans would be required for all development.

C-188: The Montana Draft EIS uses the low monthly mean stream flow. The Wyoming Draft EIS uses the annual mean stream flow.

R-188: Further coordination between Montana and Wyoming has resulted in consistent analyses of impacts on surface waters. See the Hydrological Resources section of Chapter 4. Low monthly mean stream flows are now used in both EISs, and 7Q10 low flows are also analyzed in the Surface Water Quality Analysis Technical Report.

C-189: In the Chapter 3 Hydrological Resources section, Table 3-3 (DEIS), the Gallatin River basin and the upper Yellowstone River are not mentioned. Either exclude this area or include it in the EIS.

R-189: Production data for assessing impacts is limited. This data would be acquired on a site-specific basis and included in the project-specific EAs and Water Management Plans.

C-190: In the Chapter 4 Geology and Minerals section, the Conclusion of Alternative E is that produced water could be handled in one of several ways including injection, or injection could be eliminated. With either of these conclusions in Gallatin or Park County, the mitigation relating to the same issues in my immediately preceding paragraph would be enormous—where is the mitigation?

R-190: Mitigation of produced water is discussed in the Hydrological Resources section of Chapter 4.

C-191: In the Chapter 4 Hydrological Resources section under Assumptions, it states: “For Alternative C, all CBM production water is discharged continuously and there is no storage or treatment.” This entire paragraph jumps from assumptions common to all alternatives to Alternative C. Alternative C allows for water to be discharged into off- and on-channel impoundment. How is this not storage of produced water?

R-191: See changes to text in the Hydrological Resources section of Chapter 4.

C-192: In the Chapter 4 Aquatic Resources section under Assumptions, it states, “The only management objective that applies to BLM lands and land subject to state regulations is the required placement of untreated waters from exploration activities in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed applies to BLM and state lands.” What does this sentence mean?

R-192: See changes to text in the Aquatic Resources section of Chapter 4.

C-193: In the Chapter 4 Hydrological Resources section, Impacts from Management Specific to Each Alternative—Alternative A, Conclusion, what about the Tongue River?

R-193: See changes to text in the Hydrological Resources section of Chapter 4.

C-194: In the Chapter 4 Hydrological Resources section, Impacts from Management Specific to Each Alternative—Alternative A, Conclusion, the Little Powder River would have a SAR of 47?

R-194: Depending on how Wyoming manages its CBM discharge, the resultant SAR in the Little Powder River could range from 6 to 9 during base flow periods. However, during dry periods of extremely low flow, the SAR value would be equal to the CBM discharge SAR value. This is because the majority of water supplied would result from operations.

C-195: In the Chapter 4 Environmental Justice section for Alternative C under Surface Water Quality: What does trickle-down effects mean?

R-195: See changes to text in the Environmental Justice subsection under the Socioeconomics section of Chapter 4.

C-196: In Chapter 2, Management Actions Specific to Each Alternative—Alternative C: Define what is meant by "industrial needs" and "agricultural reuse."

R-196: See changes to text under Alternative C in Chapter 2.

C-197: In Table 3-4 of the DEIS: Define the irrigation season.

R-197: Irrigation season in Montana is generally from late March through September, depending on the crop. This definition has been added as a second footnote to the table in Chapter 3 of the FEIS.

C-198: In the Chapter 4 Hydrological Resources section under Assumptions, it states, "EC and SAR Limits: based on no reduction in infiltration EC-SAR relationship future limited by suggested MTDEQ thresholds (high level): SAR < 12 for Powder River, Little Powder River and Mizpah Rivers, SAR < 2 or 12 for all other streams." This paragraph is unreadable.

R-198: See changes to text in the Hydrological Resources section of Chapter 4.

C-199: In the Chapter 4 Aquatic Resources section under Conclusion for Alternative A, it states, "Wyoming EISs and EAs found no decrease in surface water because of aquitards between production coals and surface waters." Please reconcile this statement with conclusions in the Wyoming DEIS that dewatering activities would lower water levels in the overlying Wasatch formation aquifers and alluvial aquifers.

R-199: See changes to text in Chapter 4.

C-200: It is my understanding that selenium is a concern in some of the CBM water impoundments in Wyoming. Is that being evaluated in Montana? Can concentrations of iron be expected to rise in impoundments over time? Iron acts as an antagonist to copper absorption in cattle. Are there any constituents in CBM water that, as evaporation occurs, would affect cattle production or health?

R-200: The use of impoundments will be regulated by MDEQ and MBOGC and would require water quality sampling and monitoring. Potential problem constituents, such as selenium and iron, will be monitored through these permit processes.

C-201: In the Chapter 2 Management Actions Specific to Each Alternative section under Alternative E, it states, "No discharge of produced water unless the operator has appropriate MPDES permits and can demonstrate in the Water Management Plan how discharge could occur without damaging the watershed." Table 2-2 in Chapter 2 of the DEIS states, "No degradation of the watershed would be allowed." The standard of "no damage" or "no degradation" is impossible to enforce as the definition of "damage" has not been defined in the DEIS. The DEIS does not provide an assessment of Alternative E in light of Numeric Water Quality Standards currently proposed or under review. The Preferred Alternative must be enforceable and place regulatory standards, as are done in the permitting process through MPDES.

The wording and standards set forth under Alternative E are not sufficient to provide regulatory oversight of CBM development and are not compared to those regulatory standards in place or proposed. Therefore, the choice of Alternative E as the preferred alternative is unjustified, because it is not assessed in light of water quality standards.

R-201: Alternative E (Preferred Alternative) stresses the use of Water Management Plans and MPDES permits. Water quality standards will be incorporated in each plan as it is developed. Those requirements will then become part of the permitting process as allowed under Montana law. In the Hydrological Resources section of Chapter 4, we have used a range of proposed limits for surface water quality.

C-202: In the Chapter 4 Hydrological Resources section under Assumptions, it states, "It is assumed that the sodium content … is the target contaminant …" The water produced with the coal bed natural gas is not contaminated by the production process. The water produced in the coal bed natural gas extraction process is the same as if a rancher in the vicinity were producing water for his livestock from the same coals. Coal bed natural gas production does not contaminants to the water. Therefore, "target contaminant" should be changed to "target constituent" or "target parameter."

R-202: We agree with this recommendation. The text now identifies sodium as a target constituent. In discussing the concerns for sodium and SAR, the term "concentration" is used.

C-203: Table 3-9 of the DEIS provides some analyses of regional groundwater quality; however, these data are for general characteristics, rather than specific analyses for some potentially toxic elements that are likely to be found in CBM well waters (e.g., As, Ba, Se, and Hg—the latter of which is often found in high concentrations in many coals).

R-203: Individual water quality issues will be handled through the submittal of permit applications for MPDES permits and through Water Management Plans. Specific constituents of concern can be addressed at that time.

C-204: In the Chapter 3 Hydrological Resources section on Surface Water, explain how TMDLs can be developed without holding present levels in the river, until 2005 and 2006 respectively.

R-204: The MDEQ and EPA are accelerating the development of TMDLs in the Tongue River and Powder River watersheds to allow for issuance of MPDES permits for CBM development.

C-205: EPA's analysis indicates that on average the water quality in the Powder and Little Powder rivers, which naturally are characterized by high EC and SAR, is likely to remain suitable for irrigation when untreated CBM-produced water is discharged to the rivers. This is contrary to the finding in the Montana Draft EIS, primarily due to the fact that the CBM-produced water is not as saline in the Powder River and Little Powder Rivers drainages as reported in the EIS.

R-205: The EIS used information collected from the CX ranch field and generally information on the CBM production in Wyoming to prepare the EC and SAR discussions for the Powder River Basin. Taking the conservative approach, The analyses are included in the Surface Water Quality Analysis Technical Report and summarized in the Hydrological Resources section of Chapter 4.

C-206: The Montana EIS suggests that CBM water quality may worsen as it flows overland due to dissolution of minerals. The Wyoming EIS states that little impact on CBM water quality is expected during conveyance. The Wyoming tributary study provides some information on the observed changes in water quality—generally EC worsens but SAR decreases.

R-206: The exact changes in water chemistry that occur when CBM produced waters contact the ground surface will be dependent upon the site specific minerals present, and the chemistry of the CBM water. In most cases it would be expected that these reactions will cause the salinity to increase as minerals are dissolved, and SAR to decrease when soluble minerals (such as calcite ($CaCO_3$)and dolomite (($(Ca,Mg)CO_3$)) are dissolved. However, in some cases SAR may increase (as is the case when halite (NaCl) is present), or the salinity may decrease (as is the case when iron (Fe) is oxidized and precipitated from the water).

C-207: Ongoing processes directly relevant evaluating the impacts of CBM development including proposals by both the Northern Cheyenne Indian Nation and State to establish numeric water quality standards for EC and SAR.

R-207: The timing and development of water quality standards by the Northern Cheyenne and DEQ are outside of the scope of this EIS. However, the Northern Cheyenne standards and the draft standards being considered by the Board of Environmental Review were used to define the most and least restrictive limits in the surface water impact analysis in the Hydrological Resources section of Chapter 4.

C-208: In the Chapter 4 Environmental Justice section for Alternative C, Surface Water Quality, why doesn't the EIS contain a description of the draft numeric standards being proposed by Montana and the Northern Cheyenne?

R-208: See ***R-207***.

C-209: The operations plan for the dam (agreed upon by the State, Tongue River Water Users Association, and the Northern Cheyenne Tribe in cooperation with the Department of Fish, Wildlife and Parks) calls for high flows in the spring to aid the spawning run in the lower Tongue River from the Yellowstone River, if there is sufficient snow pack. If there is not sufficient snow pack, the water is held for the irrigation season. Water is stored during the winter months for the spring irrigation season. Limiting discharge to high quality watersheds during the irrigation season will not assure that irrigators will have quality irrigation water.

R-209: Discharges will be monitored through the use of MPDES permits. Concerns about discharges that may affect irrigation waters will need to be addressed during permitting.

C-210: The TMDLs for the Tongue River should have an SAR above the dam of 1, below the dam of 1, and a wintertime SAR no greater than 1.5.

R-210: The timing and development of water quality standards by the state are outside the scope of this EIS. The MDEQ will establish limits for SAR in surface waters including the Tongue River, if approved by the Board of Environmental Review.

C-211: No information or data is presented about the long-term impacts of the saline water on livestock. Will reproduction problems be experienced? What's going to happen to our calf crop?

R-211: The National Academy of Sciences (National Research Council, 1980) has indicated that livestock water with a salinity less than 5,000 mg/l (EC less than ~

7,000 µS/cm) is "generally satisfactory, but may cause diarrhea, especially on initial consumption". Livestock water with a salinity less than 3,000 mg/l (EC less than ~ 4,300µS/cm) "should not affect health or performance, but may cause temporary mild diarrhea". The MDEQ has set a maximum goal of 3,000 mg/l (Bauder, 1999) for livestock water. As CBM water is not anticipated to have a salinity greater than ~2,100 mg/l(~3,000 µS/cm) this water should be suitable for livestock use, however livestock should initially be monitored after CBM water is provided to them, because in some cases the water could cause temporary diarrhea in animals not accustomed to such water. This problem should disappear rapidly as livestock adapt to the new water supply. Since undiluted CBM water is expected to be suitable for livestock use, surface waters that have received CBM discharges should also be suitable for this use.

C-212: Although the EIS lists Section 404 of the Clean Water Act as an agency responsibility, I can't find in the EIS a description of wetlands or other special aquatic sites as they are defined under that law or an analysis of the impacts due to coal bed methane development on these resources. Has a Section 404 B (1) guideline report and analysis been completed?

R-212: Section 404 reports are site-specific and would be addressed in EAs and Water Management Plans in which site-specific data has been collected and impacts analyzed.

C-213: What actions has Montana taken to encourage or force the state of Wyoming to cease and desist from polluting waters that flow into Montana?

R-213: In addition to the Memorandum of Understanding between the states, the FEIS coordinates the calculation of cumulative impacts on the three streams (Tongue, Little Powder, and Powder) from Wyoming and Montana CBM. The coordination will allow the BLM from both states to control CBM discharge to non impact levels.

C-214: CBM water should be tested, monitored, and filtered or cleaned before being stored in ponds or released into waterways.

R-214: Testing, monitoring and treatment of CBM waters would be parts of the Water Management Plan devised by CBM operators, and approved by the appropriate agencies, for each CBM development area.

C-215: The quality of CBM water must be inspected and approved by a certified third party inspector before it can be released into the surface water.

R-215: Qualified laboratories with no stake in the outcomes, and appropriate quality assurance and quality control procedures in place, would perform the analysis required by Water Management Plans. The results of this testing would submitted to the BLM and/or the MDEQ. Confirmatory sampling would be conducted by the regulatory agencies when deemed appropriate. Analysis of mixed surface waters at established USGS monitoring sites will continue to be conducted by the USGS to ensure that beneficial uses of surface waters are not impacted.

C-216: CBM developers should be required to clean and re-inject the water back into the ground.

R-216: Re-injection would be one water management option under Alternative E, however in cases where produced water can be managed in another manner, without causing impacts to the environment, these method would be considered as well. The actual management of water for a particular CBM project would need to be fully described in the Water Management Plan for that project, and approved by the appropriate regulatory agency. When produced water is managed of by re-injection it needs to be injected into an aquifer of equal or lesser quality than the aquifer it was derived from. Therefore there would be no need to treat the water prior to re-injection.

C-217: No water quality analysis has been completed specifically for the Bozeman Pass area.

R-217: Analysis of CBM water in all areas would be required prior to a Water Management Plan being approved. At this time there are no wells finished in the target coals in the Bozeman Pass area from which to obtain a water sample.

C-218: All methane well water must be contained in sealed reservoirs. All such waters must be treated to remove salts before surface release and/or re-injection. Containment ponds should be lined to ensure that wastewater does not seep into rivers and streams.

R-218: The actual management of water for a particular CBM project would need to be fully described in the Water Management Plan for that project, and approved by the appropriate regulatory agency. When produced water is managed of by re-injection it needs to be injected into an aquifer of equal or lesser quality than the aquifer it was derived from. Therefore there would be no need to treat the water prior to re-injection.

C-219: The EIS misleads the reader into believing that all produced water from conventional oil and gas development will be put to beneficial use, when in reality, most of it will be discharged to surface waters.

R-219: Water produced from conventional oil and gas wells likely will be managed as they have been, mostly by deep injection. CBM-produced water will be managed in accordance with the operator's approved Water Management Plan. Depending on the quality of the CBM water and the quality of nearby surface water, disposal may involve surface discharge or other options.

C-220: It is possible that a change in livestock mineral balance will result from a change in the water quality because of CBM activities. This would necessitate using more expensive mineral supplements.

R-220: It is possible, but guidance documents from the State indicate that CBM water seen in the Powder River Basin is safe for livestock.

C-221: There should be a drawdown circle of influence of 20 to 30 to 50 miles.

R-221: The best numerical models of subsurface flow indicate that drawdown will extend much less than 20 miles.

C-222: Please explain why violations will be allowed of the Standards for Rangeland Health and Guidelines adopted by the BLM. Why isn't this issue addressed in the DEIS?

R-222: Compliance with current rules and policies on livestock grazing remain the surface landowners' responsibility. All users of public lands are to be in compliance with standards for Rangeland Health and Guidelines for Livestock Grazing in Montana, regardless of whether these activities are related to livestock grazing.

C-223: A greater amount of sampling should have been completed to get a more accurate estimate of the groundwater quality.

R-223: It was not in the scope of the EIS to generate new groundwater data. Under the National Environmental Policy Act (NEPA) federal agencies are required to use the "best available data" to analyze the impacts of proposed actions.

C-224: Groundwater permits should be valid for only 1 year, renewable after inspection demonstrating that the permit holder has complied with all rules and regulations and no adjustments to the plan for groundwater disposition need to be made.

R-224: Water Management Plans are reviewed periodically by the BLM to ensure adequate compliance.

C-225: Landowners should be able to write their own water recovery proposal for CBM development and have the initiative to recover their water.

R-225: MBOGC, and BLM require the operator to offer a Water Resources Mitigation Plan to every landowner within 0.5 mile of the planned CBM development. Landowners have the right to propose their own recovery method.

C-226: The DEIS is deficient in several areas, most importantly those regarding the ability to set standards of no degradation of the watersheds under the preferred alternative and the lack of analysis of existing and proposed regulatory water quality standards.

R-226: It is beyond the scope of the EIS to set water quality standards; this is a state prerogative set forth in statutes. The FEIS discusses forecast impacts under all the management alternatives to the several proposed state standards.

C-227: The MBMG should be responsible for collecting and compiling water monitoring information.

R-227: MBMG maintains groundwater monitoring wells in the Powder River Basin. Data from these wells, and those of other persons and agencies, are compiled and placed on the Groundwater Information Center (GWIC) website, which is maintained by MBMG. MDEQ is responsible for monitoring water discharge permits.

Lands and Realty

Comments and Responses

Comment 1 (C-1): Roads will tear up and divide the prairie and will cause other negative environmental impacts.

Response 1 (R-1): Roads will cause environmental impacts, which will be minimized through mitigation on public land as described in the FEIS, Chapter 4, Lands and Realty.

C-2: If vehicles carrying equipment and materials exceed legal limits, the appropriate over-weight permits will be required?

R-2: Vehicles carrying equipment and materials that exceed legal limits will acquire the appropriate over-weight permits from transportation authorities.

C-3: If pipelines are required to support oil and gas development and will cross state roadways or occupy the highway right-of-way, either utility, occupancy, or encroachment permits will be required?

R-3: Encroachment Permits and Utility Occupancy Permits will be required for CBM-related pipelines that intersect or occupy right-of-ways of Montana's highway system.

C-4: Anytime work is located within highway right-of-way, a traffic control plan should be submitted and authorized through the Montana Department of Transportation (MDT) district office. This includes accessing the work area through state highway right-of-way rather than local roads.

R-4: A traffic control plan will be submitted and authorized through MDT district offices any time work is located within a highway right-of-way. This includes when CBM development will need to access the work area through a state highway right-of-way.

C-5: The DEIS does not address local planning and zoning concerns.

R-5: CBM development will adhere to local planning and zoning regulations that are applicable to mineral development.

C-6: The FEIS should include a plan for using a single transportation corridor and utility corridors for access.

R-6: Alternative B considered primary transportation corridors and placement of utilities within the road right-of-way. Because of the perceived resulting checkerboard land pattern, Alternative E—The Preferred Alternative encourages placing utility lines and roads in the same location but does not require the use of corridors.

C-7: Will I be able to demand that only organic practices be used on my surface property? And what about on leased BLM land?

R-7: Landowners will be able to negotiate terms into their contracts with the legal representative of the CBM developer. The definition of "organic practices" will need to be specifically defined and, if reasonable, could be negotiated. Practices on BLM lands will need to meet the present land use plan requirements as prescribed by the local BLM office.

C-8: Chapter 4, Assumptions to All Alternatives, lists acreages for land disturbances. Are the ranchers' existing trails included in this estimate?

R-8: The calculations for road disturbance are based only on new disturbance. If existing ranch unimproved roads are used, they will need to meet road construction standards to handle CBM traffic and would be considered new disturbance.

C-9: In Chapter 4, Lands and Realty, condemnation rights of the developer is discussed. Will this be the preferred method for CBM on split estate?

R-9: The FEIS has been revised to clarify this issue (see Chapter 4). Condemnation will not be the preferred method on split estates. However, surface owner agreements have been made part of the Project Plan.

C-10: In the Chapter 4 Lands and Realty section it states that surface disturbance from roads will be 30 percent more than Alternative B. Why does the preferred alternative promote more surface damage?

R-10: Alternative E (Preferred Alternative) would not require designated travel corridors with CBM development and production, and so road disturbance is anticipated to be 30 percent more than Alternative B, which requires travel corridors.

C-11: In the DEIS Chapter 4, Alternative B states, "Displace agricultural lands…" No data has been provided supporting these statements. Where are comments about increased irrigation capacity because of available water in areas where irrigation could not previously take place because of proximity to irrigation canals and rivers? Also, land value determinations do not happen until a person sells their property. To date, none of the landowners in Montana that have CBM development have sold their property.

R-11: Direct displacement of agriculture would occur where well pads and roads would be placed in agricultural fields. The Lands and Realty section of Chapter 4 has been modified to show potential benefits from utilization of well water under Alternatives B, C, and D.

CBM development may be positive in areas that currently experience water shortages by providing an additional source of water. The BLM and State have made beneficial use a priority in the preferred alternative of the FEIS and through the designation of the Powder River Basin Controlled Groundwater Area. Beneficial uses can include potable water supply, irrigation, livestock water, and other uses.

Land value determinations can be adjusted by the county tax assessor if requested by the property owner with evidence that the property value has declined after CBM development. This adjustment would be based on the present land use category and if there is a direct conflict. The purpose of a landowner request would be to reduce his or her tax consequence to the county.

C-12: An alternative is needed that considers some percentage of roads on private lands that would remain open after production and closure.

R-12: Private landowners have the right to either close access roads or leave them open. This option is a part of each alternative.

C-13: How many tons of sand and gravel are required to construct these roads?

R-13: The amount of sand and gravel required to construct roads cannot be determined without knowing the exact location and topography of each road. These calculations would be completed on a well-by-well basis as part of the development planning.

C-14: What is the total number of miles of roads required for one CBM well? What about roads to compressors, water management facilities? Where is the estimate of round trips per day?

R-14: It was estimated that each well will require 0.21 mile of two-track road, 0.075 mile of graveled road, 0.05 mile of bladed road for construction, and 0.06 mile of bladed road for operation. The Assumptions for Access Roads sub-section to Lands and Realty in Chapter 4 does not give an average road length requirement for field compressors or water management facilities. As discussed in Chapter 4 under the General Assumptions sub-section, it is anticipated that exploration wells will be visited once per day during testing and pumping. During production, wells will be visited once per week.

C-15: In Table 4-15 of the DEIS, the second footnote states that at an average of 8 wells per square mile, 2,287 square miles would be intensively impacted by intensive CBM development. At 24 wells per square mile, 762 miles would be impacted by intensive CBM development. Won't three times the number of wells impact three times the number of square miles?

R-15: As well density increases, the wells will be packed in closer together and less area will be required for the same number of total wells.

C-16: What will be the mitigation measures for private land? Will landowners have to abide by the limitation in Table 4-16 (DEIS)?

R-16: Mitigation for impacts on private land will be the responsibility of the landowner during negotiations with the CBM producer. Exceptions would be impacts on wetlands and threatened and endangered wildlife or other federal regulations that apply to private property. This table only refers to BLM administered lands, which includes split-estate lands with Federal minerals.

C-17: Why is there no discussion concerning the loss to the aesthetics of public lands from a landscape cluttered with wells and compressors? These are lands used for valid, beneficial uses by hikers, birdwatchers, and hunters.

R-17: Visual impacts are analyzed in the Visual Resource Management Section of Chapter 4 in the EIS.

C-18: Can the EIS explain the statement, "There are no legally required buffer distances between CBM facilities and residential, community or government dwellings"? What are the potential effects on nearby properties? In 82-11-111 of state law, the MBOGC is required to take measures to protect property owners. Will any mitigation measures be taken to protect homes and communities?

R-18: The use of a mandated buffer distance from residential properties or government facilities is not described in 82-11-111 of the state law. However, the MBOGC and BLM do apply conditions-of-approval to drill permits to protect surface owner operations, residences, community facilities etc. There are also, some local municipalities that have prescribed setbacks for oil and gas facilities. Other mitigation measures developed to protect human activities include the use of surface owner agreements, noise restriction for compressors and visual camouflage technics.

C-19: In Chapter 4, Alternative B states that CBM-related traffic would maintain a safe speed that would also control dust when approaching adjacent residential dwellings. Who will monitor this and how will speed limits be enforced? What will the speed limit be and what authority will landowners have in keeping traffic speeds within limits?

R-19: Landowners will need to monitor CBM traffic around their respective residences. If speeding violations are occurring, they will need to contact the CBM operator and file a complaint. It will be the responsibility of the CBM operators to enforce speed limit compliance on their employees. If speeding violations are occurring on county or state roads, local law enforcement authorities could be contacted.

C-20: In Chapter 4, Alternative B, who will enforce public access?

R-20: Public access or access for the public across privately owned land is granted by the landowner. Access across private land is governed by State Law and enforced by the local law enforcement office. Public access from a public road to BLM surface is allowed without permission from BLM or a private owner when privately owned land is not crossed.

C-21: Do well heads, field compressors or sales compressors have lights on at night? The EIS does not address the impacts of night lights scattered throughout the countryside.

R-21: CBM facilities do not have night lights. Lights may be on a drill rig temporarily.

C-22: How will irrigators be compensated for the reduced value of their land resulting from the use of CBM water?

R-22: As discussed in the Hydrology section, CBM water quality can range from good to poor quality. Application of good quality water would improve the value of land. Water discharged as part of the Preferred Alternative is not permitted to degrade water quality in the watershed, so its quality will be at least as good as existing water quality resulting in no impact.

C-23: Drilling in the Powder River area will add 26,000 miles of new roads, 50,000 miles of new pipelines, and utility corridors?

R-23: Chapter 4, Assumptions Common to All Alternatives, details the level of disturbance that is anticipated from roads and utility/pipeline corridors. Additionally, the General Assumptions section states the average production rate for the 20-year life of a well is 2.5 gpm. If full field development occurs, a total of 16,500 wells is expected. This results in 9,900 miles of new road, 23,000 miles of new pipeline and utility corridors, and 434 billion gallons of produced water. In addition, the use of combined corridors—a mitigation measure for several alternatives including the Preferred Alternative—for roads and utilities is expected to reduce these impacts by 35 percent. Produced water would not be discharged to streams and rivers in the project area, because portions would be beneficially used, lost via evaporation, and other potential losses.

C-24: This study ignored the farmers and ranchers. Private landowners and effects on them are not addressed; the EIS only addresses government land, tribal land, and state land.

R-24: Impacts on private land would be the same as those identified for public lands. The major exception is that private landowners will be responsible for negotiating project activities, mitigation, and restoration directly with the CBM producer.

C-25: Who will be responsible for damages to neighboring wells or property from methane escaping after water pressure is removed?

R-25: CBM producers are responsible for impacts or damage from their operations.

C-26: The DEIS does not mention the potential for CBM-caused wildfires in forested areas—from methane leaks, electrical fires during drilling, fires from ruptured gas pipelines, careless smokers, and gas migrating from domestic wells contaminated with methane gas—and offers no mitigation measures.

R-26: A discussion about fire, as well as fire suppression and protection measures, is included in the Lands and Realty section of Chapter 4. CBM operators would have to comply with state and federal regulations affecting operations on state and federal lands, including restrictions, liability and suppression responsibilities. CBM operators will prepare and maintain safety and emergency operating procedures for their operations. BMPs and mitigation measures, such as clearing vegetation from drill sites, having portable fire extinguishers in all trucks and around wells, phone numbers to call in case of fire, fire prevention procedures, evacuation plans, and conducting employee fire safety training would reduce or eliminate the opportunity for CBM operations to ignite wildfires. .

C-27: Federal and state agencies should join with private landowners to consider an area closure approach rather than individual road closure restrictions to control potential off-road travel and direct public use of corridor access on all land ownerships during the life of CBM development in the Powder River Basin.

R-27: The area being considered for the majority of CBM development is approximately 7 million acres.

Currently, the exact areas that will be developed are not yet proposed and the placement of roads has not yet been determined. As this information becomes available, and when and if the use or misuse of CBM road networks by the public becomes a management issue, the land use plan will be revisited to determine if more planning is needed.

Livestock Grazing

Comments and Responses

Comment 1 (C-1): The EIS does not address the effects of long-term saline consumption on herd quality, herd reproductivity or meat quality.

Response 1 (R-1): The FEIS states that the use of CBM water for livestock watering is generally acceptable for waters less than 10,000 mg/l TDS (Chapter 4, Livestock and Grazing, Alternative A). See reference for ALL 2001a, which gives more detail to suitability of water for livestock, and the effects of high saline waters on livestock.

C-2: Why aren't mitigation measures for the loss of AUMs part of the preferred alternative?

R-2: The mitigation measures would be similar to those discussed in Impacts From Management Common To All Alternatives, which is referenced in Alternative B. See the FEIS, Chapter 4, Livestock Grazing, Alternative E (Preferred Alternative).

C-3: The EIS discussion of water impoundment for livestock use does not appear to recognize that the livestock carrying capacity of the rangeland will determine the amount of CBM water than can be put to livestock use.

R-3: The FEIS does recognize that the use of CBM water for livestock watering will be a small amount of the overall amount available (Chapter 4, Livestock Grazing, Conclusions). The use of water impoundment is one of many BMPs available for CBM operators to utilize for handling produced water. In some areas of the RMP the addition of water impoundments will increase availability of forage, which will in turn increase the carrying capacity of the rangeland.

C-4: The BLM lands in Montana are subject to Standards and Rangeland Health and Guidelines for Livestock Grazing Management for Montana. Under section 43 CFR 4180.1, fundamentals of rangeland health criteria for livestock grazing are mandated. Will the coal bed methane companies be held to the same criteria?

R-4: All users of public lands are to be in compliance with standards for Rangeland Health and Guidelines for Livestock Grazing in Montana, regardless of whether these activities are related to livestock grazing. Like other oil and gas operators, CBM operators would be required to have a BLM approved weed management plan and reclamation plan for operations on BLM surface.

C-5: What will be the long-term impacts on grazing lands, in regard to production? Will it change weed, forb, and grass species?

R-5: Chapter 4, Vegetation, discusses possible permanent losses of vegetation, land use, and changes in weed and plant species. The long-term effects on grazing lands may be minimized by the restoration of production areas after completion of the CBM production. Changes to weed, forbs, and grass species can be minimized by the surface owner through negotiations with CBM operators during Project Plan preparation.

C-6: We could be faced with a mosaic of CBM facilities, well pads, etcetera, spread out through hay fields and pastures. How as ranchers are we to continue to have good productivity given that scenario?

R-6: Under Alternative E (Preferred Alternative), the surface owner will be involved with the CBM operators in the Project Plan preparation and will have input into CBM development.

Recreation

Comments and Responses

Comment 1 (C-1): How will the recreational impacts of CBM development affect local economies? Will outfitters be compensated for loss of income?

Response 1 (R-1): CBM development effects on recreation and thereby local economies can be positive or negative. Where CBM enhances a particular recreational activity, it will improve local economies. An example would be enhanced access to fishing areas bringing in more fisherman. Where CBM degrades a particular recreational activity, it will depress local economies. An example is where CBM development changes big game movement patterns. The local outfitters in the abandoned area would realize an effect, but the outfitters in the area to which the animals moved would experience a benefit. Outfitters will not be compensated for loss of income, unless it is part of the surface owner's agreement with the company.

C-2: What effects will CBM development have on hunting?

R-2: As discussed in the Chapter 4, Wildlife, new access roads are likely to increase legal and illegal hunting activities in areas not previously heavily hunted.

C-3: How will CBM-related discharges into the Tongue River and reservoir affect recreational activities in those areas?

R-3: Water discharged into the Tongue River and Reservoir will meet state water quality standards, so no effects will be observed due to water quality. If CBM water is discharged into the river, flows would increase thereby enhancing water-related recreation.

C-4: The EIS contains no provisions to safeguard hunting and fishing.

R-4: While increased roads will provide better access for recreational activities, they will also affect fish and wildlife and recreational activities associated with those populations. CBM development could displace game species, which may affect hunting in certain areas. Conversely, discharge of treated CBM water into streams currently dewatered would open up new fishing opportunities. Safeguards related to hunting and fishing include leasing stipulations that protect reservoir fisheries and concentrated recreation sites and scheduling exploration activities, where possible, to avoid peak recreation periods.

C-5: Will the property owner be held responsible if a hunter damages a well or related equipment on that person's property?

R-5: Any vandalism to private property including a well or other related equipment would be the responsibility of the person committing the vandalism. In cases where the property owner is leasing the hunting rights to their surface, they maybe responsible for damages caused by the hunting parties to any wells or related equipment. Property damage should be reported to and investigated by local law enforcement officials.

C-6: If we go forward with this development without very stringent controls, we're going to see habitat even further destroyed. This is one of the last places in eastern Montana where sportsman can go, (state land, BLM land, Forest Service land).

R-6: Access to public land will not be curtailed with this proposed project. Mitigation measures and stipulations discussed in the EIS are implemented to protect natural resources.

C-7: CBM activity should be excluded during the hunting season.

R-7: CBM-related drilling and construction activities would not inhibit hunting activities and would only temporarily disperse game populations (see Chapter 4, Wildlife).

Social and Economic Values

Comments and Responses

Comment 1 (C-1): The EIS acknowledges that CBM development will decrease property values but needs to be more specific about the causes (e.g., noise, land disturbance, reduced productivity, and loss of groundwater). Can you quantify the losses?

Response 1 (R-1): Property values could be reduced temporarily during the life of a CBM project by different factors, such as increased noise and reduced productivity, among other factors. It is difficult to quantify impacts to property values without specific proposals for an APD or Project Plan. Economic impacts would be addressed in the environmental analysis conducted for a specific proposal. The impact of actions in each of the alternatives is discussed qualitatively in Chapter 4, Social and Economic Values.

C-2: Taken from Chapter 4, Property Taxes: Property owners would experience an increase in assessed values and an increase in property taxes while at the same time those property owners dependent on irrigation would experience a decrease in production (and income) caused by the high SAR CBM discharge water.

R-2: The discussion in Chapter 4, Taxes, indicates that increases in assessed property values would be associated with improvements to properties associated with CBM development. See Chapter 4, Social and Economic Values and Response #1 for discussion on decreases in property values.

C-3: There is no discussion of the potential for residential property value depreciation associated with CBM development. The impacts need to be described qualitatively, and if possible, such losses should be quantified.

R-3: See ***R-1***.

C-4: Discussion of the effects of CBM development on local tax revenues does not adequately consider potential reductions in property values and the potential for long-term impacts on property tax revenues resulting from less productive lands and contaminated water. Will there be any mitigation measures to compensate for property tax losses?

R-4: See ***R-1***.

C-5: Landowners using the land to grow crops and cattle will suffer extreme economic consequences as a result of not being allowed to own the mineral rights to their own property. Will such landowners be compensated for surface damages?

R-5: Compensation of land owners for use of mineral rights and for land disturbance due to CBM development is discussed generally in the FEIS in Chapter 3, Private Landowner Revenue.

C-6: I cannot understand how the surface owner's individual property rights can be so blatantly ignored or the primacy of surface land owners recognized. Split estate issues are a huge concern, but the discussion of the rights of surface owners is vague and does not address compensation for surface damage.

R-6: See ***R-1*** and ***R-5***.

C-7: Can you define the costs to landowners (e.g., from reduced property value, surface damage, degraded water quality)? Will landowners be compensated for these losses?

R-7: See ***R-1*** and ***R-5***.

C-8: How will landowners be paid for the gas taken out? If I own mineral rights including coal, who pays who?

R-8: See ***R-5***.

C-9: The study examines the potential revenues from CBM development but gives little consideration to costs such as lost recreational revenues, devaluation of property values near CBM development, lost or damaged water resources, etc. Will there be any measures taken to mitigate these costs?

R-9: See ***R-1***.

C-10: In Chapter 4, the statement, "Most of this revenue would go to methane companies located out of state" is unsubstantiated. Out-of-state capital will flow into the state (if CBM development is not unduly burdened) through royalties, payments to workers and support businesses, and revenues of local entrepreneurs.

R-10: The statement from Chapter 4, Government Revenue, "Most of this revenue would go to methane companies out of state" is unsubstantiated as the comment suggests. The statement was revised to read, "Most of this revenue would go to methane companies and would accrue to the companies in the states where they are located."

C-11: Chapter 4 in the EIS specifies that most of the revenue would go to methane companies located out of state. Why didn't the previous analysis figure this out?

R-11: See ***R-10***.

C-12: The analysis of environmental effects in the EIS does not adequately describe the extent to which benefits associated with CBM development are realized by private entities located outside the planning area, while many of the costs of development accrue disproportionately to existing residents of the planning area. CBM revenues (excepting royalty payments and taxes) constitute economic benefits realized outside of the planning area, and should be identified as external benefits. The value of CBM equipment and supplies acquired from outside the planning area should likewise be identified as external.

R-12: The comment is correct, as the EIS discloses, that some economic benefits of CBM will accrue to entities (e.g., a methane company) located out of the planning area or out of state (as indicated in the Chapter 4 discussion) while the physical impacts of CBM will be located within the planning area. (See also ***R-10***).

C-13: The Gallatin Pass and Bozeman regions need to be evaluated separately because average land values and per capita incomes in those areas do not compare to those in other parts of the planning area. The EIS offers no meaningful analysis of the potential impacts that CBM development is likely to have on property values, economic development opportunities, and tax revenues in these areas. There is also no mention of potential alternatives to mitigate the losses these communities will experience under full development.

R-13: The socioeconomic analysis was conducted at the county level, in keeping with the intent of the EIS and the fact that specific CBM well locations have not been identified. As a result, a specific analysis of property values, economic development opportunities, and tax revenues in the sub-county locations identified is not appropriate or feasible. Site-specific evaluations to be conducted as part of the drilling permit process would be used to quantify changes in valuation at specific locations.

C-14: Due to high population growth rates, the homeowner and rental vacancy rates in Gallatin and Stillwater counties are significantly different from rates in other areas such as Powder River County. The text of the EIS should note these disparities in the discussion of the average rates.

R-14: The comment correctly points out that housing vacancy rates in a sub-county area may be different than the county averages reported in the text. For clarity, the following statement will be added to the discussion of housing vacancy rates in Chapter 3, Social Organization: “Although the vacancy rates reported here illustrate averages in the counties and in the planning area, sub-county variations may exist as a result of factors such as a high population growth in a portion of the county.”

C-15: Totally missing from the EIS are concerns for the impact of health, safety and general welfare issues in Gallatin and Park counties.

R-15: Gallatin and Park counties are two of the 16 counties included in the CBM planning area. Socioeconomic analysis for these two counties are provided in similar detail as the rest of the planning area counties. More detailed information on health, safety and general welfare issues for these or any of the counties is beyond the scope of this EIS.

C-16: The EIS cannot be considered complete without studies of effects of CBM development on property values in areas such as Wyoming, Colorado and New Mexico.

R-16: The impact of the alternatives on property values is discussed qualitatively in Chapter 4, Social and Economic Values. Because specific CBM well locations have not been identified, it is beyond the scope of this EIS to identify (and hence quantify) specific losses. The studies from Wyoming, Colorado and New Mexico are likely to provide useful information for site-specific evaluations to be conducted as part of the drilling permit process.

C-17: This project stimulates tremendous growth in the economy by generating additional revenue for the counties and state, and directly and indirectly creates jobs for the citizens of Montana. The EIS needs to reflect that many counties in the planning area and Montana in general need economic development and a stronger tax base. CBM development will bring much needed new jobs.

R-17: The socioeconomics portions of the EIS describe employment and income information for the state and the affected counties (Chapter 3) and the potential for change related to the CBM alternatives (Chapter 4). Attitudes, beliefs, lifestyles and values related to CBM development are also described generally in these sections. However, it is not for the EIS to judge the degree to which the economic benefits of CBM development are wanted or needed by individuals or communities.

C-18: In the section on demographics, the EIS should make clear that a declining population in the production area represents a significant need for jobs, economic development and diversification of the economy. Responsible development of CBM resources would have a very positive impact on the economy of the production area.

R-18: See ***R-17***.

C-19: A scientific poll, conducted by Montana State University at Billings and reported in the *Billings Gazette* on November 14, 2001, showed 63.2 percent of those polled supported CBM development in Montana if reasonable precautions were taken to protect the environment. Only 11 percent said CBM should not be developed, with the same percentage (11 percent) saying that it should be developed as quickly as possible. Lastly, 15.3 percent were undecided.

R-19: The results from this poll, as reported in the *Billings Gazette*, were added to the section titled Newspaper Reports in the Socioeconomics Appendix.

C-20: There is no discussion of the social-economic effects of the boom and bust development that will occur with CBM. What will be the long-term effects of abandoned production facilities, pipelines, roads and commercial and residential developments on the economic health of our communities? In particular, what will be the effect of a "bust" cycle on our public facilities?

R-20: Although not labeled as such, a "boom and bust" cycle of economic development is illustrated to some extent in the socioeconomic analysis presented. For example, the jobs and wages tables shown in Chapter 4 of the EIS are associated with various phases of CBM development. These demonstrate a pattern consistent with this concept. The general conclusions made with respect to public services and utilities apply to communities' ability to respond to the long-term costs and benefits of CBM.

C-21: Can you provide an analysis of the long-term costs to wildlife, fisheries, tourism, and agriculture? How about long-term effects on schools and other public facilities? Will there be any mitigation measures?

R-21: Several sections of the EIS analyze in depth the potential physical impacts of CBM on natural and cultural resources. The Social and Economic Values section includes a discussion of jobs and wages and a qualitative analysis of economic impacts on public services and utilities and water resources values. However, further analysis or quantification of long-term economic impacts is not feasible given available information and the scope of the overall document.

C-22: Can you discuss the cumulative effects to water quality and quantity associated with CBM development? Will there be any protections? The potential economic impacts of changes to water quality and quantity warrants more detailed discussion than what is in the EIS. Will users, including agricultural users, be compensated for water quality degradation and reductions in available supply? Who will pay?

R-22: Effects to water quality and quantity are discussed in detail in the Hydrological Resources sections of Chapter 4. The differences in management of produced water, and mitigation for impacts on water quality and quantity, are discussed there and in Chapter 2 (Alternatives). The potential economic impacts on water resources associated with the various alternatives are discussed qualitatively in the socioeconomic impacts section of Chapter 4. However, a more detailed or quantitative analysis is beyond the scope of this document.

C-23: The EIS does not address the potential for impacts of CBM development, and its resulting industrial traffic, on children attending school in close proximity to such operations.

R-23: While CBM development would bring additional truck traffic to selected locations, any air pollution associated with this traffic would not be at levels that would impact human health. See also the discussion of roads in Chapter 4, Lands and Realty.

C-24: The EIS ignores the myriad costs to agriculture of CBM development, including effects on productivity and water supplies. Have pre-development baseline data for agricultural economics in this area been collected so that the losses from CBM development can be documented? How will agricultural businesses be compensated for their losses? Will ranching remain viable after CBM development?

R-24: Costs to agriculture from CBM development would be related to physical disturbance of the land or water or to changes in the socioeconomic environment. Physical changes to soils and water are discussed in the Soils and Hydrological Resources sections, respectively, of Chapter 4. Socioeconomic impacts, including jobs, employment, and water resource values, are discussed in the Socioeconomics section of Chapter 4. Mitigation for impacts is discussed generally in Chapter 2 (Alternatives) and specifically for each of the alternatives in each of the resource sections. Further quantification of costs to agriculture is beyond the scope of this document.

C-25: Can the EIS address the indirect impacts on agriculture such as the impacts of lower land values on farm loan availability, terms, and collateral?

R-25: The potential for impacts on land values is discussed in Chapter 4, Impacts From Management Common to All Alternatives. To the extent that agricultural land values are lowered, they could have indirect impacts such as those described in the comment. However, a quantification of such impacts is beyond the scope of this analysis.

C-26: What will be the costs of dewatering aquifers and who will pay the costs, particularly after the boom times? How will these costs be quantified?

R-26: Aquifers will not be dewatered; see discussion in Hydrological Resources section of Chapter 4 for discussion of physical impacts on water resources. Economic impacts associated with water resources are discussed qualitatively in the Socioeconomics section of Chapter 4.

C-27: What will the effects of CBM development be on community social structures? The EIS does not address this or show how communities will benefit from CBM development.

R-27: Community social structures—assumed generally to mean the status quo of a given community—could be affected (positively or negatively) by changes to a number of factors. The Social and Economic Values section of Chapter 4 analyzes changes to the primary factors—population, housing, employment, public services and utilities, attitudes and beliefs, income and revenues—in relation to the CBM alternatives being considered. Because the location of individual CBM wells has not been established, a more detailed analysis of impacts on specific communities is not feasible as part of this document. Site-specific evaluations will be conducted as part of the drilling permit process.

C-28: Will farmers be compensated for losses incurred during reclamation?

R-28: Surface owner compensation would be paid by the well owner as negotiated in the surface owner agreement that is required prior to initiation of work on private lands.

C-29: What effects will CBM production have on the region's economy and its cultural values? The impacts on recreation, tourism, and agriculture will be staggering. What protections will there be?

R-29: Impacts of the CBM alternatives on the regional economy and on cultural values are discussed in the various subsections of the socioeconomics analysis in Chapter 4. See also ***R-39***.

C-30: Will public sector revenues be sufficient to offset public sector costs? The EIS does not offer sufficient quantifying detail to determine this.

R-30: Impacts on public sector costs and revenues are discussed for each alternative in the "Public Services and Utilities" and the "Government Revenues" sections of the socioeconomics analysis in Chapter 4. The comment is correct in stating that the document does not quantify all costs and benefits in a way that allows them to be compared quantitatively. Instead, qualitative conclusions are made based on the level of information available.

C-31: What costs will be incurred by municipalities like Glendive, which depends on Yellowstone River water as its drinking water supply? What will it cost to treat water polluted by CBM development to meet the standards of the Safe Drinking Water Act?

R-31: Potential physical and economic impacts on water resources are discussed in the Hydrological Resources and Social and Economic Values sections, respectively, of Chapter 4. Further quantification of costs is beyond the scope of this EIS.

C-32: In Chapter 3, the EIS should clarify that public services are dependent on the tax base of the county and community where the services are employed.

R-32: The following statement was added to the end of the Public Services and Utilities paragraph in Chapter 3, Public Services and Utilities: "Public services are generally funded by tax revenues, although there may be other sources of revenue (e.g., user fees, utility franchise fees). The tax base of the county or community where public services are employed is often a key component of this funding."

C-33: The EIS incorrectly assumes that CBM property taxes will provide benefits to local government. The only property taxes that apply to CBM are business property taxes, and these are scheduled to phase out by 2006.

R-33: The comment is correct. The only property taxes that apply to CBM development are business property taxes, and these are scheduled to be phased out by 2006. The text was revised to reflect this change. This change does not affect the quantitative economic information provided in the analysis.

C-34: The EIS analyzes employment as if CBM workers would live close to where they work. Experience indicates, however, that most workers are likely to live in Wyoming as will the white collar workers. The EIS should address where workers are really likely to live and limit general statements about personal income increases.

R-34: The EIS acknowledges that individual choices about where to live are difficult to predict (Chapter 4, Housing Units and Vacancy). Because of the nature of the EIS, only general analyses of housing supply (Chapter 3, Social Organization) and demand were attempted. However, if some workers would choose to live in Wyoming as the comment suggests, the size and potential impacts of new population in any given location in Montana would be reduced.

C-35: Why was Sheridan not considered as a place where workers would reside?

R-35: See ***R-34***, above.

C-36: CBM development could create a short-term increase in school enrollments, but any increases in tax revenues would lag behind. As a result, school budgets will not keep pace with costs unless voters approve mill levies as a "fail safe." Can the EIS address this issue?

R-36: The potential lag between an increase in school enrollments and increases in tax revenues is acknowledged. However, it does not change the conclusions of the analysis.

C-37: The analysis of the effects on personal income needs more detail. Discussion on p. 4-87 alludes to losses but does not quantify them.

R-37: Changes to personal income are described in Chapter 4. Further quantification is not feasible at the level of this analysis.

C-38: Although the effects of wage substitution are mentioned briefly, the analysis contains no real discussion of the offsetting effects of job and income substitution against job creation associated with CBM development. This analysis should also consider the effects on employment of reductions in agricultural land.

R-38: The comment correctly points out that job and/or wage substitution could occur as a result of the influence of new CBM jobs, as mentioned in Chapter 4, Social and Economic Values, in the Personal Income section. A more detailed analysis would require specific information on the location and number of wells at a given location and at a given time. Given the nature of this document, such analysis is not feasible.

C-39: Can you provide more detail on the effects of CBM development on jobs associated with recreational and agricultural enterprises? How will disruptions in these industries affect the overall economy of the state and region?

R-39: Analysis of the effects of the CBM alternatives on employment, income, and revenues are discussed in the socioeconomics section of Chapter 4. Although specific sectors of the economy, such as recreation and agriculture, could be affected, further quantification of impacts is not feasible given the nature of this document.

C-40: The EIS contains no analysis to support the assertion that a significant number of jobs resulting from CBM development will be filled by existing residents of the planning area (DEIS 4-76, 4-80).

R-40: The text from Chapter 4 states that CBM jobs would be filled by a mixture of local labor and in-migrants. This conclusion is based on the discussion of existing labor force and employment statistics presented in Chapter 3 and on the types of jobs anticipated to be available as discussed in Chapter 4, Social and Economic Values.

C-41: Past, present and future employment in the petroleum industry was not reviewed in the detail given other industries. Since this EIS is about petroleum development, it seems a curious oversight.

R-41: Employment trends by major sector are shown in the Social and Economic values section of Chapter 4. While further information on petroleum industry employment might be interesting for reference, the more general employment statistics reported here are adequate for the level of analysis needed to disclose the impacts of the alternatives.

C-42: How many jobs would be created in Montana?

R-42: Potential new jobs related directly and indirectly to CBM development are discussed for each of the alternatives. Precise numbers of total jobs created were not estimated and would not be useful to the analysis due to the range of factors and the uncertainties associated with them.

C-43: In Chapter 4, a study is referenced for Alternative A. Aren't the actual numbers of jobs created known for the CX Ranch field? Table 4-9 of the DEIS should be obsolete if known wages are attainable. Are any of the employees paying income tax in Montana?

R-43: Because of the relatively smaller scale and preliminary stage of CBM development on the CX Ranch, the data from the Anderson ZurMuehlen report cited on in Chapter 4 provided a better estimate of jobs creation for the CBM alternatives. The estimates of wages in the Social and Economic Values section tables are the best available and are based on actual wages in the CBM emphasis area.

C-44: The discussion of state income tax revenues should note that federal taxes are generally deductible in Montana.

R-44: While it is accurate that federal taxes are generally deductible in Montana, this fact does not change the results of the economic analysis presented.

C-45: Have comparative economic estimates and analyses been done to establish that the proposed CBM plans are economically viable for the state?

R-45: The economic viability of the CBM development plans is beyond the scope of this analysis.

C-46: The EIS places a much greater emphasis on quantifying the economic benefits of CBM development versus its discussion of the costs associated with CBM development in the planning area. While the costs associated with dispersed CBM development may be difficult to quantify, a reasonable effort should be made to ensure a balanced presentation of both the benefits and the costs of potential development. A draft without this information is incomplete.

R-46: The comment is correct in stating that quantitative economic information on CBM costs is much less available than on CBM benefits. For this reason and because of the nature of this analysis, qualitative information was used in many cases. However, it does not follow that the analysis of economic costs and benefits of the alternatives is unbalanced or incomplete.

C-47: In its assessment of the attitudes, beliefs, lifestyles and values of residents in the planning area, the EIS relies on several sources whose applicability is open to question. For example, the study relies on information from the 1986 report *Natural Resource Development in Montana* (referenced on page SEA-3 of the Socioeconomics Appendix in the DEIS). Montana's demographic profiles and many of the socioeconomic/cultural values of its citizens have changed since 1986. While certain components of the 1986 report are undoubtedly still valid, others have changed, or changed in relative importance, in the past 16 years.

R-47: The information on Attitudes, Beliefs, Lifestyles, and Values presented in the Socioeconomics Appendix is based on a number of sources, including some that are relatively old. Limitations on the applicability of some of this information to individuals or specific population subgroups are discussed in the Socioeconomics Appendix and in Chapter 3.

C-48: There is no discussion of the cumulative socioeconomic effects of CBM development in Wyoming and on private lands both within and outside the planning area.

R-48: Cumulative effects are discussed in the conclusions section for each alternative found in Chapter 4, Social and Economic Values. Potential impacts of future CBM development in Wyoming were beyond the scope of this analysis.

C-49: Where is the data on the socioeconomic effects of CBM surface water discharge and groundwater impoundment to downstream communities?

R-49: A general discussion of the socioeconomic impacts of water resources impacts is included with the analysis presented for each alternative, Chapter 4, Social and Economic Values.

C-50: Can you address the effects of property devaluation in the affected area on the rest of the state?

R-50: The potential for property devaluation and appreciation in certain locations and circumstances is discussed in Chapter 4, Impacts From Management Common to All Alternatives. Property value changes in the CBM planning area could affect the state as a whole. However, because specific CBM well locations have not been identified, it is not possible at this time to identify specific property value changes. Site-specific evaluations to be conducted as part of the drilling permit process would be used to quantify changes associated with a given location.

C-51: The EIS does not include an adequate discussion of the increased demands on mental health agencies, emergency medical services, drug and alcohol treatment centers, law enforcement agencies and fire control capabilities likely to result from CBM development. The effects on county services should also be analyzed in connection with projected development on reservations.

R-51: The potential impact on public services and utilities is discussed for each of the alternatives in Chapter 4, Social and Economic Values. Additional detail regarding quantitative impacts and impacts at the sub-county level will be addressed in subsequent site-specific analyses.

C-52: Can you explain the statement in Chapter 4 that "Any resulting increases in demand on public services and utilities are anticipated to be within the capacity of the providers"? Accounts from Wyoming indicate the opposite is true.

R-52: See Chapter 4, Social and Economic Values, for additional text. Because additional workers will be required, a population influx will occur affecting housing, city and county services, recreation, and other public services. However, because the changes in population would be moderate and dispersed throughout the CBM emphasis area, any resulting increases in demand on public services and utilities are anticipated to be within the capacity of the providers.

C-53: There is no support for the assumption in the EIS that real estate price escalation would be associated primarily with an increased demand for "small ranchettes" (EIS 4-75). While the analysis describes the presence of temporary housing opportunities "in and around the large cities ... as well as major tourist or recreation areas" (EIS 3-52), there is no description provided for the relative availability of temporary housing in the planning area. The relatively high homeowner and renter vacancy rates for the planning area (EIS 3-52) suggest, however, that the demand for housing associated with CBM development would be unlikely to result in a significant appreciation in local real estate values. In addition, the oil and gas industry historically is associated with an increase in temporary and modular housing, not "ranchettes."

R-53: The sentence from Chapter 4, Impacts From Management Common to All Alternatives, that stated "Small ranchettes located within the area would increase in value because of the demand for additional housing" is unsubstantiated and was deleted.

C-54: Why are the most recent vacancy housing estimates in the EIS based on 1990 data?

R-54: This information has been updated with data from the 2000 census.

C-55: Is there a mechanism for landowner input on drilling and leasing and mineral estate issues? Will private landowners be notified prior to beginning of work?

R-55: For landowners without mineral rights, gas operators are required by law to notify the owner prior to initiation of work and to enter into an agreement with the surface owner. The agreement typically addresses the location of wells, roads, etc.

C-56: The EIS does not consider an Alternative in the section "Alternatives Analyzed in Detail" analyzing social and economic and environmental impacts on surface owners of Federal minerals. What would be the effect of such an Alternative and why did not the current analysis deal in detail with this situation?

R-56: The potential for environmental and socioeconomic impacts on surface owners of federal minerals is addressed in the analysis of the alternatives. For example, economic impacts related to surface owners are discussed in Chapter 4, Attitudes, Beliefs, Lifestyles, and Values, Personal Income.

C-57: The EIS needs to provide better and more detailed analysis of costs and benefits related to impacts in the areas where they are most likely to occur—the high CBM potential areas. Big Horn County is projected to have 7,000 or 38.3 percent of the total 16,500 wells in the RFD. Our county does not have the resources to research the potential impacts; we must rely on the EIS to disclose this information and to provide reasonable options for mitigation.

R-57: The potential for greater socioeconomic impacts in the areas where the most CBM wells would be located is acknowledged in the socioeconomics section of Chapter 4. However, a more detailed analysis of such impacts is not appropriate given the level of this EIS document.

C-58: The EIS needs to provide more information regarding road and bridge operations. Experience in Wyoming shows that existing roads are used extensively and are not, as the EIS claims, lightly traveled. Who will pay to maintain private bridges used for CBM development and operation? What is the basis for the statement on p. 4-83 that the majority of new roads would subsequently become county roads? Will tax revenues increase to cover this added cost?

R-58: The sentence from Chapter 4: "Although the construction and maintenance of utilities would be funded by the users, the majority of new roads created to access CBM wells would subsequently become county roads" was revised. It now reads: "The construction and maintenance of utilities would be funded by the users. The decision as to whether to maintain roads upon abandonment of CBM facilities will be up to the land owner, which could be either a public or private entity." Assumptions regarding abandonment of roads for the various alternatives are provided in Chapter 2.

C-59: The quantity of economical oil and gas resources and market implications is not addressed in the discussion of socioeconomic effects. It is unlikely that the amount of gas produced from within the planning area would have a significant effect to national energy supplies or prices.

R-59: Energy markets and energy supply considerations are beyond the scope of this analysis.

C-60: The economics of mitigation strategies is not addressed in the discussion of socioeconomic effects. Mitigations are not required under the existing legal and regulatory environment and would need to be included in the ROD stipulations in order to be effective.

R-60: The proposed mitigation strategies have been screened for economic feasibility. However, an analysis of the economics of mitigation strategies is beyond the scope of this analysis.

C-61: Where is the economic analysis supporting the conclusion that the mitigation measure to reinject CBM discharge water is economically infeasible?

R-61: Reinjection in this case is understood to mean injecting produced water back into the coal seam from which it was extracted. This option to reinject coal into the same zone or aquifer was rejected on technical (not economic) grounds, as discussed in the section "Alternatives Considered But Not Analyzed in Detail."

C-62: The socioeconomic analysis in Chapter 4 states that negative impacts could occur to irrigation from Alternative C, but none of the impacts are quantified. This section goes on to confuse the issue by contradicting the hydrological section. In Alternative E, the Preferred Alternative, the socioeconomic analysis states that this is the "most protective of water resources," which is counter to the conclusions from the hydrology section.

R-62: The statement in Chapter 4, Alternative E, under Attitudes, Beliefs, Lifestyles, and Values, it states, "Alternative E would be the most protective of water resources and water resources values of all the alternatives being considered" was changed. It now reads: "Alternative E would have impacts on water resources and water resource values that are between the impacts of Alternative B and Alternative C (see Hydrological Resources section)." An estimate of the qualitative economic impacts on water resources is provided for each of the alternatives, allowing them to be compared on this basis. However, a quantitative analysis is beyond the scope of this document.

C-63: Chapter 3 states, "The taxes and royalties assessed on oil and gas development and production are an important source of revenue for local governments and the State." A sentence should be added regarding oil and gas production taxes distributed to the counties so that the chart can be inserted or can be referenced in the Appendix. The chart has quarterly distributions, but a table of calendar year totals would likely be sufficient and more clear. The text should state: "A percent of state-levied oil and gas production taxes are distributed to the counties based on the county where production occurred. For natural gas, 86 percent of the production taxes are distributed to the counties for local governments and schools. For oil, 60.7 percent of the production taxes are distributed to the counties."

R-63: In Chapter 3, under the State Oil and Gas Lease Income section, the recommended sentences were added after the sentence that ends, "…and local property taxes on drilling and production equipment" and before the sentence that begins, "See the Socioeconomics Appendix."

C-64: An additional table of the oil and gas production tax distribution to the counties would be relevant in this section.

R-64: While this additional information would be relevant, as the comment suggests, it would not add substantial new information relative to the analysis and comparison of alternatives.

C-65: Citing responses that "are likely to be biased" is not productive.

R-65: The information from the newspaper opinion survey, along with the caveat that the responses may be biased toward those persons who were concerned about CBM, was provided in the interests of summarizing available information on public opinions.

C-66: Income levels in Gallatin and Yellowstone counties, where a very small portion of foreseeable development is likely, are considerably higher than in other counties included in the planning area. If the per capita average were calculated without these two counties, the statistics and analysis would be far more accurate and useful.

R-66: The document provides the per capita income information suggested in the comment. The Social and Economic Values section of Chapter 3 shows per capita income for each of the project area counties and illustrates the differences among the counties.

C-67: In the Chapter 3, Social Organization section, if the EIS cannot attribute it to other cause, remove the word "possibly" or amend this statement to: "This trend is highly indicative of a poor economic climate."

R-67: The two statements concerning economic climate in relation to housing supply are beyond the scope of this analysis and were removed.

C-68: In Chapter 3, how many public scoping comments were received? Please include an additional table in the EIS showing this breakdown.

R-68: There were 311 scoping letters received with a total of 2,100 comments as part of the scoping process. A summary of the process and the letters is provided in the Final Public Comment Summary and Recommendations (March 20, 2001) document. This document is available on the CBM portion of the Montana Department of Environmental Quality web site, http://www.deq.state.mt.us/coalbedmethane.

C-69: Page SEA-1–Scoping (DEIS) is the process used to identify the issues to be addressed by the EIS. It is not a comment process. Moreover, the agencies repeatedly stressed that very point prior to and during the scoping process. It is outside the bounds of NEPA and MEPA for scoping submittals to be used as anything other than what is intended or to be used as a bona fide survey of attitudes. Therefore, scoping submittals should not be considered comments.

R-69: The document is correct that the purpose of the public scoping process is to receive input on the issues to be addressed in the EIS and to help shape the study. The comments also provide information on attitudes and values associated with a proposed project. The summary on p. SEA-1 was prepared in this light and not in the context of scoping the study.

C-70: Taken from Chapter 3, “The percentage of royalties disbursed in Montana is much greater than the national average.” This statement should be corrected to advise the reader that, under current federal legislation, Montana receives 50 percent of the net receipts on lease bonuses and rents and the applicable royalty revenue. Table 3-27 of the DEIS should be updated to reflect fiscal year 2001 information.

R-70: The text was revised to reflect this comment. The sentence in Chapter 3, Socioeconomics, reads, “The percentage of royalties disbursed in Montana is much greater than the national average” will be revised to read: “federal legislation provides that Montana shall receive 50 percent of the net receipts of all bonuses, rents and royalties collected on BLM-administered lands within Montana. As a result, the percentage of royalties disbursed in Montana is much greater than the national average.”

C-71: Why is Stillwater County not part of more discussion in the EIS?

R-71: Stillwater County is discussed throughout the socioeconomics analysis in Chapter 3, Chapter 4, and the Socioeconomics Appendix, as relevant.

C-72: It appears that there are overstatements related to the number of wells, sales price and the longevity of the production cycle of CBM development in Montana. The EIS needs to present supporting documentation for these assertions.

R-72: Assumptions regarding the number of wells are discussed and documented in the RFD scenario document for the purpose of focusing the analysis of the EIS. Further information on the assumptions regarding the production life of the wells is provided on the responses to comments on the Hydrological Resources section of the document.

C-73: The economic analysis currently presented in the EIS is no more than an estimate of revenue from CBM.

R-73: This comment is incorrect. The socioeconomic analysis discusses economic costs and benefits from CBM development in accordance with the goals of this document (disclosure of potential impacts of alternatives), the level of detail, and the availability and appropriateness of quantitative and qualitative information.

C-74: Regarding Chapter 4, won’t the zoning requirements of a community supersede the mineral rights?

R-74: Zoning codes describe the allowable use for a given location or piece of property. The zoning code would generally restrict the sorts of activities related to mineral extraction that could be conducted in a given location. However, because zoning codes and allowable uses vary by jurisdiction, there is no single answer to the question.

C-75: On page SEA-1 (DEIS), the conclusion that the study area population “may feel reluctance toward short-term developments that will alter their lifestyle” appears to be biased and unfounded.

R-75: The statement referred to in the comment is one of several general statements applicable to a specific population sub-group. It is based on the information sources discussed in the subsequent pages of the Socioeconomics Appendix.

C-76: Because the unscientific poll on page SEA-2 (DEIS) was taken at a particularly busy time (early calving, intensive feeding, etc.) for those in the area most likely to be considered for development, many were likely unable to find the time to participate in a survey they had no way of knowing would later be used in this type of document.

R-76: The likelihood of limited participation in the newspaper opinion survey is already acknowledged in the document. The information from the survey, along with the caveat that it may be biased toward those persons who were concerned about CBM, was provided in the interests of summarizing available information on public opinions in the absence of a statistically validated survey.

C-77: What is totally missing from the EIS is any analysis of the potential revenue from development.

R-77: Quantifying the revenues that would accrue to CBM developers is beyond the scope of this document and is not relevant to the analysis of alternatives. However, the indirect effects of this revenue—wages paid to workers, purchase of supplies and equipment, payment of taxes—are included in the analysis.

C-78: Why is the Anderson ZurMuehlen study not included in its entirety in the EIS? Proposed CBM development activities would generate $4.1 billion in benefits but would be virtually costless. Is that a correct summary of the ZurMuehlen study results?

R-78: The Anderson ZurMuehlen study (ZurMuehlen, A. 2001) was used in this analysis as a source of information to estimate the number and types of jobs that could result from CBM development. However, the study and its conclusions were not otherwise used as a basis for the socioeconomics analysis in the EIS, in part because the study focuses on the revenues from CBM and not the economic impacts that are important to the EIS.

C-79: Why are there no alternative scenarios estimating the socioeconomic impacts under different assumptions for key variables (e.g., gas price and number of in-migrating people)?

R-79: The same assumptions regarding gas prices and number of in-migrants were used for all of the alternatives analyzed. These assumptions are considered reasonable for the purposes of this analysis. While the actual numbers could be different than the assumptions, the differences would not change the relative impacts of the CBM management alternatives under consideration.

C-80: Missing data includes capital and operating costs and profitability of currently operating wells and fields in all different parts of the Powder River Basin, capital and operating costs and profitability of new wells and fields, including the costs of different water production and disposal options, and profitability estimates of CBM ventures.

R-80: While a CBM producer's capital and operating costs are important to the overall economic success of CBM development, these costs are not relevant to the analysis of socioeconomic impacts on the communities in the analysis area with respect to the CBM alternatives being considered.

C-81: How much money would the project generate that could be provided for more effective remediation?

R-81: Mitigation measures are developed to offset impacts and can be financed in a number of ways. There is not a direct relationship between potential CBM revenues and the funds available to pay for mitigation measures.

C-82: Table 3-19 of the DEIS does not identify current or recent oil and gas employment in the state or the affected communities. Why not? The U.S. Census Bureau report contained statewide oil and gas employment from 1969 to 2000 for oil and gas extraction. Why doesn't the EIS have at least that amount of information?

R-82: The data provided in the table showing employment trends by sector was the best available at the time the EIS was produced. While potentially interesting, the additional statewide employment information cited in the comment would not provide substantial additional information with which to evaluate the alternatives.

C-83: What proportion of the gas and bonus revenues shown in Table 3-27 of the DEIS were derived from CBM development?

R-83: The requested information is not readily available. However, because there is relatively little CBM development currently in the emphasis area, relatively little of the gas or bonus income would be due to CBM.

C-84: Why does the Montana EIS assume that the average life of a Powder River Basin CBM well would be 20 years, but the WY EIS assumes that an analogous well in WY would only last 5 to 7 years? This assumption is a very large positive boost to total revenues and profitability of Montana's potential CBM production.

R-84: The comment is correct that the total revenues expected from a given well correspond to assumptions about the life of the well and that different well life assumptions are used in the Montana and Wyoming documents. The reasons for the differences relate primarily to a number of site-specific assumptions that vary by location. Further information on the assumptions regarding the production life of the wells has been added to Chapter 4, Assumption Rationale, CBM Well Production Life.

C-85: Why doesn't the Montana EIS economic analysis examine the higher royalties that are typically paid to private landowners within the Powder River Basin? Royalties as high as 20 percent are used in EPA economic analysis for private Wyoming landowners.

R-85: Private landowner royalties from mineral rights are summarized in the discussion of county per capita income. As discussed in Chapter 4, Attitudes, Beliefs, Lifestyles, and Values, Personal Income of the EIS, private landowner income accruing to an individual could be substantial but the effect of this income on per capita income in the CBM emphasis area or the state would be small. As a result, individual private landowner royalties are not quantified.

C-86: Why does the Socioeconomics Appendix end so abruptly and without a conclusion?

R-86: The Socioeconomics Appendix contains detailed information to support the background information provided in the socioeconomics section of Chapter 3. Interpretation of this information is incorporated into the analyses in Chapter 3 and Chapter 4. The appendix is not a stand-alone document.

C-87: Why doesn't the EIS investigate the costs of downhole separation of gas and water?

R-87: Downhole separation of gas and water for CBM is not a common practice due to technical limitations and is not currently used for CBM development anywhere in the United States. For this reason and because this issue was not brought up during project scoping, it is not analyzed in the EIS.

C-88: The EIS needs to address disproportionate impacts that may affect populations in certain parts of the planning area such as Rosebud County, Powder River County, the Amish community, and any low income populations.

R-88: As discussed in Chapter 3, Low-Income and Minority Populations, of the EIS, potential impacts on populations were identified at the county level, in accordance with the scope of this study. The potential for disproportionate impacts on populations in Big Horn, Powder River, and Rosebud Counties is acknowledged in a number of places in the analysis (e.g., p. 4-80). More detailed analysis of such impacts is beyond the scope of this study.

C-89: The EIS should analyze the burdens, direct and indirect—economic, social, cultural, environmental or health—that would come from the proposed action.

R-89: These impacts are analyzed and discussed in the socioeconomics sections of this document.

C-90: Why does the EIS not address the potential long-term economic loss of fish and wildlife recreational activities from lowered species populations?

R-90: The FEIS addresses this potential economic loss in Chapter 4 in the Social and Economic Values section.

C-91: The EIS makes no mention of the potential impacts that full-scale development could have on small rural volunteer fire districts.

R-91: Along with the increased risk of wildfire comes an increased demand on local fire departments and federal and state fire fighting organizations. These impacts are discussed in the Social and Economic Values section of Chapter 4.

C-92: What will the economy of Eastern Montana look like after the CBM is gone?

R-92: The comment appears to refer to the potential for boom and bust. See ***C-20*** and ***R-20***.

C-93: There needs to be a discussion of the economic feasibility of water treatment.

R-93: The various water treatment alternatives described in Chapter 2 (Alternatives) and in the Hydrological Resources section of Chapter 4 are integral parts of the alternatives. The treatment options will be the responsibility of the CBM developers. While the treatment options were screened for feasibility as part of developing the alternatives, the economic feasibility (e.g., costs to CBM developers or operators) is beyond the scope of the assessment of economic impacts of CBM on the affected communities.

C-94: I'm opposed to mining of CBM, because when I asked people who worked in CBM production they said they had certain effects from it, and you're talking about 20 years from now.

R-94: Human health was not identified as an issue during the scoping process. However, it is addressed in the Environmental Justice sub-section of Chapter 4 (contained in the Social and Economic Values section). Companies have a responsibility to inform their employees and others affected by their operations about safety and health issues and procedures.

C-95: The character of the demographics as it goes on 5, 10, 15, 20 years in the future and beyond is just inadequately addressed.

R-95: As described on p. 4-75 of the DEIS, the time period for analysis for socio-economic impacts is 20 years, based on the average production life of a CBM well. Although impacts beyond this time are not quantified, the discussion on that page acknowledges that such impacts could occur.

C-96: I want more in-depth study as to what kind of impact it's going to have on not only this generation, but for seven generations from now, and even longer.

R-96: See previous comment and response.

C-97: What about the tribal report on those aspects of the reservation's physical, social and cultural environment which will likely be affected by CBM development?

R-97: The FEIS incorporates socioeconomics information from the recent Crow and Northern Cheyenne tribal reports (see Chapter 3).

C-98: The impacts and mitigation analysis do not address the social, economic and cultural impacts on the Northern Cheyenne Tribe in any fashion that is responsible and meaningful. There is no mention of impact on springs, no talk of water supply issues, no social or economic implications, no real mitigation strategies or ideas.

R-98: The socioeconomics section of Chapter 4 discusses impacts at the county level, based on the assumed locations of CBM wells in the future. Because specific CBM well locations have not been identified, it is beyond the scope of this EIS to identify or quantify impacts more specifically. Site-specific evaluations to be conducted as part of the drilling permit process would be used to quantify changes associated with specific locations.

C-99: I would also ask that they reinject the water, because not doing so affects everyone else in the neighborhood. I would also ask, if you own your mineral rights and you don't want to develop them, a buffer zone is set so that your minerals or your water cannot be taken that you can some day have a claim on.

R-99: Injecting produced water back into the coal seam from which it was extracted was rejected, as discussed in the section Alternatives Considered But Not Analyzed in Detail. Assumptions and impacts related to below-ground resources are discussed in the Hydrological Resources section of Chapter 4.

C-100: CBM development will increase the tax base, but when the gas is gone the jobs will be gone, when the jobs are gone the tax base will be gone, and so will be the oil companies. We'll be left with a deteriorating infrastructure and mortgages to pay and no money to pay them with.

R-100: See ***R-20***.

C-101: The EIS talks about the jobs and the taxes and all that, but what it doesn't talk about is what's going to happen to the economy after CBM is gone.

R-101: See ***R-20***.

C-102: It looks like we've got an assumption there that that is not currently viable since you say when it becomes viable or when and if. I wonder what data you used to make that assumption, if there's been an economic study done.

R-102: Existing economic conditions and potential economic impacts are discussed in the socioeconomics sections of Chapter 3 and Chapter 4, respectively.

C-103: I don't think the EIS is complete until we have an economic analysis of all sorts of different water options.

R-103: See ***R-22***.

C-104: Anderson ZerMuehlen study came out and had lots of benefits for CBM development, but it was unable to find any costs associated with that development.

R-104: See ***R-78***.

C-105: There is no discussion in the EIS on the cumulative socioeconomic impacts of methane development in Wyoming.

R-105: See ***R-48***.

C-106: A tax change occurred in 1999 that went into effect in 2000 and eliminated local government severance taxes. The EIS should include a more accurate classification of oil and gas production taxes that are returned to the counties.

R-106: This tax change does not affect the conclusions or general presentation of data. However, the change was noted. The following sentence was added to the end of the second paragraph under Natural Resource Taxes: "(Note: The Oil and Gas Production Tax was eliminated after 1999.)"

C-107: We anticipate that CBM development will severely impact the quality of our ranch's current operations, as well as our long-term investment.

R-107: See ***R-1***.

C-108: There is no accountability to state or federal agencies or to the methane industry for the impacts that they will cause agriculture.

R-108: Impacts on agriculture could occur as a result of changes to soils and water, as discussed in the relevant subsections of Chapter 4. CBM activities will not proceed without the approval of the EIS and compliance with applicable state and federal laws.

C-109: In Table SEA-2 of the DEIS, you can see that those counties with mineral production, because it's a non-mill-levy revenue source, have the lowest mill levy. So in the section on taxes, if there could be mention that the oil and gas or mineral production taxes offset the property taxes that are needed to support the county, and therefore there is a mill-levy reduction that everyone in the county experiences when there's oil and gas or mineral production in that county.

R-109: This information was added to Chapter 3 of the FEIS. Prior to the sentence, "See the Socioeconomics Appendix for more information on taxes," the following sentence was added: "Generally, as county oil and gas production tax revenues increase (e.g., because of new oil and gas production), the property tax rate (mill levy) for the county is decreased accordingly."

C-110: The impacts on the local area that weren't addressed in the EIS, and those are farmers, ranchers' dollars that come to town, primarily Miles City, Custer County, was totally missed by the EIS.

R-110: See next comment and response.

C-111: Miles City is going to be impacted, at least in my viewpoint, and so I'm just really disappointed that our own BLM office didn't see fit—there's even a BLM office there, and they didn't even see fit to hold a hearing in Miles City.

R-111: Miles City is located in Custer County. Custer County is one of the counties included in the socioeconomic analysis. The socioeconomic analysis was conducted at the county level, in keeping with the level of the EIS and the fact that specific CBM well locations have not been identified. Site-specific evaluations to be conducted as part of the drilling permit process would be used to quantify changes associated with specific locations.

C-112: You haven't addressed impacts in Miles City.

R-112: See previous comment and response.

C-113: There are no legally required buffer distances between CBM facilities and residential, community or government dwellings. Placements of roads and well pads near residential businesses and community dwellings may cause direct reduction of property values.

R-113: See ***R-1***.

C-114: I would suggest that, within the Socioeconomic Appendix, it references a series of articles that were done by the *Billings Gazette* and also talks about peoples' attitudes, Montanans' attitudes about this development, and they reference a point-and-click poll that was on an internet website that the document itself admits was not scientific. That said, if you do want a poll to reference Montana's attitudes, there was a scientific poll conducted by MSU Billings.

R-114: The information from the MSU Billings poll was incorporated into the Socioeconomics Appendix (see ***R-19***).

C-115: How will we attract tourists, clean, high-tech and white-collar industries and business into Montana if we allow our cherished landscapes to be sacrificed to the short-term profits of the CBM industry? Why has this seminal issue not been addressed in the EIS?

R-115: The mitigation measures described in Chapter 2 are intended to minimize impacts on the environment, including the landscape. The attraction of other business and industry to the area would depend on a number of factors including labor force, economic climate, and availability of markets.

C-116: Drug and alcohol use is increasing, which will lead to an increase in motor vehicle accidents. Are you going to fix the roads?

R-116: The construction and maintenance of roads and other utilities would be funded by the users. The decision as to whether to maintain roads upon abandonment of CBM facilities will be up to the land owner, which could be either a public or private entity. See further discussion in the Lands and Realty section of Chapter 4.

C-117: And there's going to be people coming in—strangers—and they're going to be bringing in drugs, there's going to be rape, and there's going to be unwanted pregnancies again.

R-117: The potential for population influx associated with the various alternatives is discussed in the Social and Economic Values section of Chapter 4. Because of the geographic scale of the CBM development scenario, it is infeasible to quantitatively assess the relationship of the project to specific public services. However, increases in the demand for such services are anticipated to be within the capacity of the providers.

C-118: A separate Economic Impact Study should be conducted, much like the one commissioned by the Durango, Colorado, County Commissioners' Office (2).

R-118: The social and economic values section of Chapter 4 discusses potential economic impacts of the project on the surrounding communities, in keeping with the purpose, scope, and requirements of an EIS.

C-119: If water quality for irrigation could be degraded by large-scale CBM production, perhaps some method of compensating people not to irrigate would benefit ranchers, fisheries, and CBM producers.

R-119: Mitigation measures, including compensation where relevant, are discussed in Chapter 2. A Water Management Plan, which would prevent and/or address water degradation, would be required for the Preferred Alternative.

C-120: The EIS does not include the impact of CBM production on property values and the impact of CBM production on the local economy and the potential decrease in tourism .

R-120: Potential effects on property values and the regional economy are discussed generally in the EIS. See ***R-1*** and ***R-29*** for further discussion.

C-121: CBM development needs to be distanced from residences by adequate protective buffer zones of greater than 200 feet. This should include all aspects of CBM development, including roads, pipelines, and drilling facilities.

R-121: CBM development under the Preferred Alternative (see Chapter 2) would require an approved project plan when well densities are greater than 1 well per 640 acres. The project plan would address potential landowner impacts.

C-122: The EIS must address potential alternatives to mitigate the losses that property owners will have if CBM development takes place.

R-122: CBM development under the Preferred Alternative (see Chapter 2) would require an approved project plan that would address potential landowner impacts.

C-123: Landowners should be compensated for overhead powerlines and roads on a per foot rate per year.

R-123: CBM development under the Preferred Alternative (see Chapter 2) would require an approved Project Plan that would address potential landowner impacts.

C-124: Do the population estimates presented in Table 3-15 of the DEIS assume large-scale development of Powder River Basin CBM, or are they assumptions based on little or no additional CBM-based development?

R-124: The numbers provided in this table are from the Montana Department of Commerce, Census and Economic Information Center. Chapter 3 does not assess the potential impacts from CBM development and therefore these numbers do not nor should not assume CBM development.

Environmental Justice

Comments and Responses

Comment 1 (C-1): It is acknowledged in the document that 45 percent of the populations in the three counties that will be the focus of development are Native American; yet more than 90 percent of the population in the 16-country region is of European descent. Thus, Native Americans will incur a large and disproportionate percentage of the negative impacts; at the same time, Euro-Americans will enjoy the vast majority of the economic benefits.

Response 1 (R-1): Although 45 percent of the population in the Big Horn, Rosebud, and Powder River counties are Native American, the majority of these individuals also reside on the reservations where no CBM development is planned by the BLM or state. If the reservations are to be developed, this will be a decision of each respective tribe. Off-reservation development and impacts on the reservation is dependent upon site-specific conditions and the extent of development in proximity to the reservations, which will dictate the degree of impacts on a reservation and/or the people living there. These potential affects will be analyzed in subsequent site-specific analyses.

C-2: The range of alternatives considered does not include any geographic limitations on CBM development that might lessen impacts upon Native Americans.

R-2: Alternatives B and D addressed the implementation of a 2-mile buffer zone around the reservations for federally managed minerals. See Chapter 2, Indian Trust Resources.

C-3: Alternative E (Preferred Alternative) rejects a number of measures that could lessen the environmental impact upon the tribal communities. Most of those measures have to do with potential impacts upon surface water and groundwater.

R-3: Alternative E requires operators to develop a Water Management Plan to protect surface water from discharges and to ensure that there is no undue degradation to watersheds. In the case of the Northern Cheyenne, once the Tribe's draft water quality criteria are finalized these numbers would be applicable and used to develop Water Management Plans in the Tongue

River and Rosebud Creek watersheds upstream of the reservation. See the Alternative E—Preferred Alternative discussion in Chapter 2.

C-4: Does the environmental justice issue somehow disappear if the non-replacement areas are not adjacent to a reservation?

R-4: The environmental justice issue is a Federal Action issued under Executive Order No. 12898 (February 11, 1994) and pertains to the disproportionate effects of federal actions on minority and low-income populations regardless of location or proximity to a reservation.

C-5: Where do we find the actual mitigation requirements for the Environmental Justice section?

R-5: The mitigation measures are discussed independently depending on the particular resource area being impacted or discussed under Environmental Justice. For example, the potential drawdown of groundwater resources from a reservation may constitute an environmental justice issue and is discussed under the Environmental Justice section, but the detailed mitigation measures for groundwater impacts are addressed under the Hydrology section in Chapter 4.

C-6: Environmental Justice should identify interest of the Crow Tribe and Crow Reservation as a planning issue.

R-6: The interests of the Crow Tribe and Reservation are addressed in the Environmental Justice section of Chapter 4.

C-7: The groundwater impact discussion in the Environmental Justice section should consider impacts on the Crow Tribes' ability to market their water as a commodity.

R-7: See new text under Environmental Justice for the Crow Tribes' water marketing.

C-8: Which number of wells in Wyoming—51,000 or 6,000—is used for the analysis in Alternative A?

R-8: The analysis in Alternative A utilized the latest Wyoming RFD estimates for well completion over the next 10 years, 51,000 wells.

C-9: How will issues of Environmental Justice be addressed subsequent to this issuance of a final ROD? What processes does State DEQ/BLM have in place to deal with Environmental Justice issues?

R-9: After completion of the ROD, the BLM will address Environmental Justice issues during the environmental analysis of specific proposals and subsequent mitigation measures included with approved permits. The state does not have an environmental justice responsibility; it is only a federal responsibility as defined in Executive Order 12898.

Soils

Comments and Responses

Comment 1 (C-1): Farming and ranching will be impacted by the effects of salinity in the water. The EIS does not address the long-term effects of land recovery and salt accumulation. Increased salinity of water will have negative consequences on native plants as well as cultivated agricultural crops.

Response 1 (R-1): Potential impacts on soils from the discharge of high saline CBM water are discussed in the Soils Appendix. Additional detailed discussions are included in the Soils Technical Report (ALL 2001a). Specifics concerning the disposition of CBM water with respect to soil impacts will depend on the quality of the CBM water, the types of soils present, and the intended use or disposal of the CBM water. Impacts on soils and other resources from the discharge of CBM produced water will be evaluated when proposals are made, along with appropriate mitigation measures.

C-2: Drainage and permeability are not synonymous. Assumptions used in the EIS that include use of soil amendments and high irrigation application rates do not address the quality of the leachate and the receiving water, which may exceed Montana's water quality standards, if applied. No evaluation is made of the impact of precipitation to create an imbalance in the ionic balance in the soil. Such an imbalance may further the development of sodic soil crusts.

R-2: As stated in the Soils Appendix, soils that exhibit good internal drainage would have a higher permeability than soils that do not exhibit good internal drainage. The use of soil amendments and high irrigation rates are a means to mitigate the effects of the SAR and salinity levels in CBM water if used for irrigation purposes. Water exceeding the Montana water quality standards may or may not be useable for irrigation depending on treatment and permit requirements. The development of sodic crusts will depend on the types of soil present, the quality of the water applied to the soils, the rate of application, and the overall quantity of water applied.

C-3: What are the mitigation details for negative impacts for soils and plants? If this water is discharged untreated, or applied operationally to the land, it will permanently change the soils. At best, it will require the perpetual application of this water and, at worst, it will render the soils unfit for any use.

R-3: Mitigation measures for soils and plants are discussed in Chapter 4 under the headings Soils and Vegetation. Under Alternative E (Preferred Alternative), a Project Plan and Water Management Plan would be required that would outline specific elements and mitigation measures based on site-specific conditions such as the quality of the CBM water, types of soils present, and the potential for impacts on plants and wildlife.

C-4: Will containment ponds or impoundments be sealed in sandy soils? What is the likelihood that impoundments will be reclaimed? How long after these impoundments are abandoned will it take for the salts to leach up to the surface when it rains?

R-4: Both BLM and MBOGC have regulations that detail how impoundments should be constructed and whether or not they should be lined. Whether or not a particular impoundment is reclaimed will depend on the surface agreement established between the landowner and the CBM operator. Some landowners may request that the impoundment not be reclaimed to allow for livestock watering. The leaching of salts to the surface after a rainfall should not occur if the impoundment is lined or if it is properly restored and reclaimed.

C-5: What are the impacts on soil resulting from the application of CBM water as it relates to SAR and EC? There is a lack of clearly defined and defended criteria for SAR and EC. The EIS indicates that SAR values less than 3 are not considered a threat to crops and native plants. The source of these criteria should be cited. Please explain how high-SAR water applied to roads and work pads will affect the reclamation of the roads and well pads at the end of a project.

R-5: The impacts on soils from the application of CBM water as it relates to SAR and EC are discussed in Chapter 4, Soils. A more detailed discussion of these impacts is included in the Soils Technical Report (ALL 2001a). Specific criteria for SAR and EC would depend on site-specific conditions such as water quality and soil type. The source of the statement describing the SAR value of 3 as not a threat to crops is the Soils Technical Report (ALL 2001a). Under Alternative E (Preferred Alternative), the reclamation of roads and well pads will be outlined in the Project Plan. Soils impacted by high SAR may require removal and replacement with stockpiled topsoil or the application of amendments to restore the soil.

C-6: The DEIS is incomplete in addressing the effects of soil erosion and salinization on the well-being of wildlife, aquatic life, and agriculture. How can the DEIS be considered complete when it lacks the soils study that it states in the preface of the DEIS is being conducted with the BLM Wyoming office?

R-6: Potential impacts from soil erosion and salinization are discussed under their respective headings in Chapter 4. Additional details are provided in the Soils Technical Report (ALL 2001a) and the Water Technical Report (ALL 2001b). Under Alternative E (Preferred Alternative) site-specific proposals outlined in the Project Plan would have with appropriate mitigation measures. NEPA instructs us to use the best available data. New information from studies are incorporated into the land use plan when it becomes available. A number of studies are currently ongoing or planned to provide additional information that will allow for the better management of area resources with respect to all uses, not just CBM development.

C-7: CBM development in Wyoming has created jobs for hydrologists, engineers, water resources managers, wildlife consultants, fish-stocking consultants, and others whose full-time occupations involve finding uses for water, protecting lands from erosion, and mitigating disturbances from water production. Developers and regulatory officials have learned how to successfully manage water. For example, nearly all CBM water is discharged through energy dissipation systems that prevent erosion at the outfall or discharge point. Erosion is rarely a problem.

Of course, all water moving through a stream channel will contribute to movement of sediments. Powder River is little more than a large natural sediment-moving system, affected much more by weather than by man. Increased flows in a more stable stream channel like the Tongue River will not create erosion problems. Steady flows in intermittent and ephemeral channels will move less sediment than flash floods and sudden snow melts, the natural events which cause heavy erosion in many places. Appropriate stipulations in discharge permits will minimize erosion. Accordingly, it is not appropriate to repeatedly state in the EIS that CBM development will cause extensive erosion.

R-7: The unregulated discharge of CBM produced water would result in the erosion of area soils and resulting increased sedimentation of area streams and rivers. The evaluation of erosion potential and the implementation of mitigation measures, as outlined within a site-specific Project Plan under Alternative E (Preferred Alternative), would allow for the proper management of CBM water and the implementation of erosion control measures as stated in the comment.

C-8: What effect will the increased water have on erosion of soils and stream banks? Steep hills are easily eroded and some areas are not suitable for roads or containment ponds. Erosion can increase the TDS level of streams. How will this affect the EC and SAR of the streams? The EIS states that BMPs and design construction will be used to control erosion and sedimentation, but the EIS does not identify the effectiveness of such BMPs.

R-8: The impacts on soils from erosion are discussed in Chapter 4, Soil and in the Soils Appendix with additional detail provided in the Soils Technical Report (ALL 2001a). Under Alternative E (Preferred Alternative), a Project Plan would be developed which would include and evaluation of the potential for erosion and the implementation of appropriate mitigation measures that could include engineered structures and BMPs which are well established for erosion control. The construction of roads or other structures on steep slopes would be avoided to mitigate the potential for erosion. Increased erosion would not increase the TDS level in streams. It could increase the total suspended solids levels in streams. This would not be expected to have any effect on the EC or SAR level in the stream water.

C-9: What will be done to remediate impacted soils and what is the timeframe for implementing remediation or restoration measures? How much will remediation cost, and will companies be required to post a reclamation bond to cover the costs of third-party cleanup and reclamation of soils and impoundments? Would the amount of the bond be enough to cover the removal and disposal of sodium-affected soil under the impoundments as well as other reclamation costs? Who is going to be responsible for the implementation of site restoration measures and who is responsible for monitoring site restoration activities?

R-9: The potential impact on soils and mitigation measures are discussed in Chapter 4, Soils. Remediation measures, methods, and timeframes will be dictated by site-specific conditions and, under Alternative E—Preferred Alternative, would be outlined in the Project Plan. Impacted soils could either remain in place and be remediated or be excavated and disposed of in accordance with applicable regulations.

Surface agreements also would be required to specify which areas and structures would be restored and which would remain in place. Surface impoundments, roads, and site structures would either be restored or left in place according to the surface agreement between the CBM operator and the landowner.

Water mitigation agreements would be required where water resource supplies are impacted. Bonds for well abandonment and site restoration would be required. The actual cost of site restoration and required level of bonding would be determined on a case-by-case basis. The CBM operator will be responsible for implementing site restoration activities. Monitoring of impacts and site restoration activities would be carried out by the BLM and MBOGC or other agency as appropriate.

C-10: Monitoring requirements should include monitoring of soils in irrigated farmland and riparian areas. Levels need to be set for acceptable salt content and plans adopted for dealing with increased levels of salts in soils. Monitoring should also include produced water effluent and stream water.

R-10: Monitoring requirements are outlined in the Monitoring Appendix. Under Alternative E (Preferred Alternative), a Project Plan would be required that could include additional monitoring requirements based on site-specific conditions.

C-11: The harmful effects of dust and soil pollution from facility and road construction and the increase in traffic associated with this type of activity must be addressed.

R-11: The impacts, as well as mitigation measures, of dust from site activities such as facility construction, road construction, and road use are discussed in Chapter 4, Soils.

C-12: The EIS fails to adequately assess the affects of the disturbance of topsoil and the affect on microorganisms such as fungi and algae.

R-12: The potential for impacts on soils and mitigation measures to protect site soils, including topsoil, are discussed in Chapter 4, Soils. Mitigation measures that would be implemented to protect site soils from impacts would inherently protect the microorganisms in those soils.

C-13: The DEIS lacks a basic introductory overview of SAR and EC soil and water chemistry principles and the effect of sodium adsorption on soil structure and infiltration. An explanation of the Hanson curve and what it means to be above the line and below the line need to be included. What are the indirect impacts of decreases in soil productivity on farming and ranching viability, on riparian vegetation, wildlife habitat, and on wildlife populations?

R-13: Detailed discussions of SAR and EC soil and water chemistry principles and the effect of sodium adsorption on soil structure and infiltration are included in the Soils Technical Report (ALL 2001a), the Water Technical Report (ALL 2001b), the SWQATR (ALL, 2002) and in the Hydrology section of Chapter 4. Impacts on area resources are included in Chapter 4, Livestock and Grazing (for ranching), Soils (for farming), Vegetation (for riparian vegetation), and Wildlife (for wildlife habitat and populations).

C-14: What studies have been done to determine the soil conveyance loss? Are different types of soil taken into consideration? What effect does surface gradient have on infiltration? If this water is infiltrating the ground, what is keeping it out of the ground water aquifers that feed the rivers? Would putting high SAR and EC water into surface aquifers be illegal? Explain how water infiltrates frozen ground and how the water will infiltrate the soil when it becomes saturated. Please explain how the water will infiltrate after the soil structure has collapsed as a result of the salt water.

R-14: The conveyance loss used in the FEIS was based on data from Wyoming CBM sites and the CX Ranch field in Montana. Different soil types were not taken into consideration. Parameters relating to water infiltration rates are discussed in the Soils Technical Report (ALL 2001a) and Water Technical Report (ALL 2001b). Utilizing CBM water to recharge surficial aquifers would be assessed on a case-by-case basis and would require the approval of the appropriate agencies.

C-15: Where is the baseline study of the soils along the Yellowstone River below the Powder River?

R-15: The study is being conducted in conjunction with the BLM Wyoming office and will be available in the spring of 2003.

C-16: Why did the agencies fail to respond to issues listed under "Soils" in Chapter 1?

R-16: These issues are addressed in Chapter 4 in the Soils section, in the Soils Appendix, and in the Soils Technical Report (ALL 2001a).

Solid and Hazardous Waste

Comments and Responses

Comment 1 (C-1): Will the landowner be notified that he is responsible for all hazardous materials placed upon the land? Can a landowner deny access to his property of any "hazardous substances" since the landowner is liable?

Response 1 (R-1): Under CERCLA regulations, landowners are responsible for waste generated on their property. However, under the Montana Code Annotated (1999), Title 82, Chapter 10, Part 505 states "The oil and gas developer or operator is responsible for all damages to property, real or personal, resulting from the lack of ordinary care by the oil and gas developer or operator. The oil and gas developer or operator is responsible for damages to property, real or personal, caused by drilling operations and production." This statement places the liability of cleanup that results from spills or unused non-exempt waste (paint, acid or other chemicals) to the oil and gas developer and operator.

C-2: What will be done to protect landowners from damage to their land and water by the spilling of waste during maintenance or construction activities?

R-2: See ***R-1***.

C-3: We don't want herbicides or pesticides used on our property. What alternatives will the CBM companies use?

R-3: Landowners who do not wish to have pesticides or herbicides used on their property should include such information in their surface use agreements. The landowner and CBM operator can agree to other methods (e.g. the construction of a vehicle wash station) for controlling the spread of noxious weeds.

C-4: The EIS needs to more fully analyze specific impacts on Big Horn County related to solid waste.

R-4: The FEIS is designed to address issues related to CBM development across the entire State. Issues related to site-specific concerns are to be addressed in Plans of Development, and general impacts from solid wastes are found in Chapter 4. Water Management Plans and development EAs.

C-5: Analysis of Alternative E, the Preferred Alternative, will have impacts similar to Alternative B. The EIS indicates that under Alternative B, "The increased volume of solid and hazardous wastes would result in local landfills reaching capacity sooner." The Hardin landfill has a remaining life expectancy of approximately 25 years, and is unlikely to last through CBM development with projected effects of any alternative except Alternative A, No Action.

R-5: If the expected remaining life of the Hardin landfill is 25 years, it is likely that any development alternative but A would shorten that life expectancy.

C-6: The EIS should consider that not all CBM wastes are disposed of directly in local landfills, and that the wastes can cause significant costs to local government and remote canister sites. The EIS should identify measures to ensure prevention and monitoring procedures and the enforcement of existing state and federal regulations. It should also include ways to mitigate increased costs to local government and the need for new or expanded landfill facilities.

R-6: The FEIS states in Chapter 4, Solid and Hazardous Waste, Assumptions, "All wastes generated by oil and gas including CBM … would be disposed of in accordance with regulations." In addition, in Chapter 2 of the FEIS under Management Common to All Alternatives, there is discussion of what agencies are responsible for monitoring and enforcement activities.

Because of the short life and shallow depth of most CBM wells, there will not be as much solid wastes produced as is typical during conventional oil drilling activities. Also, CBM drilling does not use materials considered hazardous while drilling. No special disposal costs would be associated with the drilling. If any hazardous materials were on a CBM site, they would be the responsibility of the company to remove and dispose of in a approved facility (for hazardous materials this would not be a public landfill). The operators will pay fees associated with disposal in private landfills. The operators will be taxed on their gas production; these funds will be included in public funds that may be allotted for the construction of public landfills.

Vegetation

Comments and Responses

Comment 1 (C-1): We are concerned about the liability to the state and taxpayers like ourselves who may be left with the clean-up costs after methane development is over.

Response 1 (R-1): Oil and gas, including CBM, operators are required by BLM and the State to properly reclaim disturbed areas and clean up after completion of lease activities. Both BLM and the State require operators to maintain adequate amounts of bond coverage. Termination of bond liability does not occur until after reclamation and clean up work has been completed to the satisfaction of surface owners and permitting agencies.

C-2: The EIS must include surface protection for the land, vegetation, and water resources.

R-2: Federal and state oil and gas leases include stipulations designed to protect other resources. Other protective measures are described in each of the Alternatives, including Alternative E-Preferred Alternative and Table MIN-5 in the Minerals Appendix. The permitting agencies can include requirements designed to protect resources and land uses with approved permits.

C-3: The lowered water table will increase desertification and erosion. How will a lowered water table impact native grasses and sensitive plants, and important habitat such as woody draws and naturally sub-irrigated meadows?

R-3: As stated in the EIS, shallow aquifers should be isolated from water withdrawal in lower aquifers. This would minimize impacts on surface vegetation that is dependant on the shallow water table. An evaluation of impacts will be made for individual permit applications and measures taken to avoid or minimize impacts on sensitive vegetation.

C-4: Loss of flow in springs and the drying out of natural wet meadows could cause livestock to seek out forage in existing, more permanent riparian areas, placing greater impact upon these areas.

R-4: Where possible, alternative water sources will be developed as part of operator plans and mitigation measures. CBM water will be made available for livestock, which should reduce the impact of livestock grazing in riparian areas.

C-5: The proliferation of new roads, pipelines, well sites, compressor sites, and other project-related disturbances will result in a huge number of newly disturbed sites that will favor colonization by exotic weeds.

R-5: Operators will be required to aggressively control weeds. Chapter 4 under Vegetation in the Assumptions section states, "The BLM has co-developed an action plan for weed containment and eradication practices that will be implemented for all alternatives (BLM 1996). Pertinent sections of Appendix 3 from that document are reproduced in the Vegetation section of Chapter 4. The action plan applies to the State's list of weed species of concern (see the Vegetation Appendix)."

C-6: What will be done about weeds in the areas where produced water reservoirs exist after the CBM project is finished?

R-6: The operator will be responsible for reclamation of disturbed sites, which includes weed control.

C-7: The BLM DEIS says that lessees and landowners will be required to monitor and control weeds, but there is nothing to indicate how this requirement will be enforced, or how they will be compensated.

R-7: Each landowner is encouraged to negotiate and work with producers to establish development procedures on their property. These negotiations should address weed-control activities. Compensation must be negotiated between the landowner and the producer.

C-8: The EIS references a weed action plan. What about private surface above federal minerals?

R-8: BLM is actively involved with operating plans and weed prevention and control. BLM has the responsibility and authority in these cases and works with the landowner to make sure their interests are taken care of by the lessee or operator.

C-9: Will landowners have the right to require all vehicles totally cleaned at an off site property owned by the operator before they enter a surface owner's property?

R-9: The BLM's weed action plan requires cleaning equipment prior to moving into weed-free areas.

C-10: Reclamation of native vegetation will be difficult, especially given the probable invasion of exotic weeds that compete with and crowd out native species. Is there a mitigation plan in place?

R-10: Mitigation plans, which include re-vegetation and weed control will be developed as part of each permit to drill application.

C-11: Before development proceeds, the agencies should collect thorough plant inventories.

R-11: Vegetation surveys will be conducted on federal and state lease areas before beginning operations. Information from the surveys will help determine seed mixtures used in reclamation. Plant clearance surveys will also be conducted for sensitive species before beginning operations.

C-12: From Chapter 4, will a time limit be set for reclamation of disturbed areas?

R-12: Although commencement of reclamation is variable and project specific, the reclamation bond for each project is not released until reclamation is judged successful.

C-13: The Minerals Appendix states, "The planting of grasses, forbs…must be approved by the appropriate agency." Need to clarify that approval is needed when the "appropriate agency" is the surface owner or trustee and not when the surface is privately owned.

R-13: The EIS wording will reflect the concept that the approving agency may in fact be a private landowner on private land. However, even on private land, there are requirements to prevent the establishment and spread of noxious weeds, which may require reclamation of disturbed land.

C-14: Too much water, even of good quality, can drown plants.

R-14: The application of water for irrigation would need to be carefully monitored to ensure that plants are not over or under watered. If CBM produced waters are to be managed by land application, this use must be covered in the CBM operators Water Management Plan. These plans must be reasonable if they are to be approved.

C-15: Our native plants and most crops can't survive with the high level of dissolved salts found in methane water.

R-15: Produced water must be tested for water quality before it can be put to a beneficial use including land applications or irrigation. Only water of suitable quality, either before or after treatment, would be available to be used in beneficial uses. Existing data shows that the quality of water produced with CBM varies and not all of it is highly saline.

C-16: It is critical that the effects of increased SAR on plant production and viability was clearly stated in the narrative. Will this be done?

R-16: Effects of high SAR water are discussed in the Vegetation and Soils sections of the EIS.

C-17: A salt-tolerant crop selection should be addressed (generally low yields, poor quality feed and forage).

R-17: Each rancher or farmer can consult with the Natural Resource Conservation Service and County Extension agents for information about site-specific conditions related to crops, water quality and soils.

C-18: What are the consequences of coal bed methane wastewater on the land and crops? How much soil will be lost?

R-18: The EIS discusses the impacts on soils and crops from CBM water in the Soils section of Chapter 4. Additional discussion can be found in the Soils Technical Report (ALL 2001a).

C-19: Although a large amount of data has been included, it is not site-specific and is inadequate in describing the affected environment. For example, there are only two sentences that refer to riparian areas and neither refers to any site-specific riparian areas. No reference is made to numerous site-specific studies of the project area.

R-19: The EIS addresses broad-scale, generalized impacts on resources. It is not possible in this document to address site-specific impacts because no specific sites have been identified. Site-specific analyses will be completed as part of the analysis for each well permit application.

C-20: There are no references to wetlands or the moist habitats surrounding natural springs and seeps, or their location. There is no discussion of how they function in the affected environment and how they would be affected by development, or where replacement wetlands would be located.

R-20: A wetland discussion has been added to the Chapter 3 Vegetation Section which, addresses wetlands in the project area. Since specific well locations have not been identified, describing impacts on specific wetlands is not possible in this document. Replacement wetland locations cannot be identified until the location and extent of specific impacts are identified. These activities (identification and mitigation) will occur at the time a 404 permit application is prepared for wetland impacts resulting from well installation or other project activities.

C-21: In Chapter 4, the EIS states that drilling sometimes may occur in or near areas that support riparian vegetation or special status plants. Roads and facilities are supposed to avoid sensitive areas to the extent practicable. Please reconcile this statement with the statement from Chapter 4, Vegetation, that existing stipulations will protect most riparian areas and certain wildlife habitats?

R-21: Sensitive areas, including riparian areas, would be avoided to the extent practicable as stated in the EIS. However, avoidance may not be possible in all cases, so some development may occur in sensitive areas. Pre-development clearance surveys and projects designed to avoid impacts will be used to minimize the effects from development in sensitive areas.

C-22: In Chapter 4, the statement that the direct impacts on riparian areas would be similar to Alternative A (250 producing wells and another 300 or so exploration wells). How can this be when Alternative B includes 18,300 wells?

R-22: During exploration and development, wetlands and riparian areas are specifically protected from direct impacts under all alternatives. Therefore, there should be little direct impact on riparian areas with any alternative. See Chapter 4-Assumptions: "Under all alternatives, most riparian areas and certain wildlife habitats (see the Wildlife section) are protected from direct impact under current stipulations on BLM land that restrict surface occupancy but not road crossings (BLM 1994)." Crossings would come under each activity (identification and mitigation) at the time a 404 Permit application is prepared for wetland impacts resulting from crossing activities.

Regarding indirect impacts, which may be what the comment is about, the writer is correct; there will be large differences between alternatives because of the use and disposal of water. Alternative C has the largest potential for impact on riparian areas because discharge of untreated water onto the surface would be allowed. Alternative D would have the next greatest impact because the same amount of water would be discharged to the surface, although it would be treated first. Alternative E would have the least impact of the action alternatives, but even Alternate A (No Action) will allow discharge to the Tongue River from the CX Ranch of up to 1,600 gallons per minute. Alternative B has implications for groundwater quality. All have implications for groundwater abundance.

C-23: In Chapter 4, the statement that direct impacts on riparian areas are similar to Alternative A. How can this be when Alternative A is no development and Alternative C allows development of 18,300 wells with discharge of CBM wastewater into intermittent streams, impoundments and directly onto the surface?

R-23: Alternative A is not "no development," but it is limited development to the CX Ranch. Direct impacts are limited to riparian areas on all alternatives (see ***R-22***).

C-24: The EIS mentions that user-created roads will result in additional loss of vegetation and increase potential spread of noxious weeds, but it offers no mitigation for this. Will landowners be compensated?

R-24: The following text has been added to Chapter 4, Vegetation: "On private lands, the landowner will negotiate with the producer before exploration and development and come to an agreement as to what measures the producer will initiate for weed control site restoration and what criteria constitutes successful site restoration and proper weed control."

C-25: The groundwater loss causes trees to slowly start drying out and dying off. This also could cause a lot of stress on the trees, which could cause an outbreak of the pine beetle attacks on the standing green timber stands that could kill thousands of acres of timber stands annually.

R-25: In general, conifers which would be attacked by pine beetles are dry land species and do not rely on groundwater for support. Groundwater below pine stands is usually very deep. This can be evaluated on a case-by-case basis as part of the project-specific analysis completed for each well permit.

C-26: Although the EIS lists Section 404 of the Clean Water Act as an agency responsibility, no description is included of wetlands or other special aquatic sites as they are defined under that law. Nor is there an analysis of the impacts from CBM development on these resources. Has the Section 404 b(1) guideline report and analysis been completed?

R-26: Vegetation types were identified from the Montana Gap Analysis Project. Wetlands and other special aquatic sites are not defined in that database. One could assume that wetlands would be associated with the riparian vegetation type. The 404 b(1) guidelines will be used at the project-specific level, but are not appropriate without a specific project location to evaluate.

C-27: In areas where CBM water is to be discharged, crops should be developed that are able to tolerate the condition of the water.

R-27: Produced water must be tested for water quality before it can be put to a beneficial use including land applications or irrigation or discharged onto the surface. Only water of suitable quality, either before or after treatment, would be available to be used for beneficial uses or discharged onto the surface.

C-28: The most serious threat to the region's biodiversity comes from the habitat fragmentation created by CBM development.

R-28: Habitat fragmentation has been considered in the impact analysis and lease stipulations and mitigation measures have been incorporated into the Preferred Alternative to curb the effect and provide protection to targeted species habitat.

C-29: How will the companies stop exotic plant growth along roads?

R-29: Operators will be required to develop and implement weed action plans which would include exotic plants.

Visual Resource Management

Comments and Responses

Comment 1 (C-1): How about mitigating the visual quality concerns by establishing some guidelines?

Response 1 (R-1): The EIS outlines mitigation measures to reduce the visual impacts of CBM wells and compressor stations. These represent guidelines that will be followed during development.

C-2: How do we apply for Class I or II Visual Resource Management (VRM) status?

R-2: VRM status applies only to surface lands managed by the BLM and is assigned by the BLM in the planning process based on a variety of elements related to visual quality and the view shed. Copies of the criteria are available by request from the BLM.

C-3: What compensation will there be to surface owners for the devaluing of their land and other economic hardships they will incur because of the visual impacts of CBM development? Is damage to visual impacts taken into account when assessing damage to property values and pre-existing businesses?

R-3: Compensation will be determined through agreements between the surface owner and the mineral owner.

C-4: The EIS does not have any reference to where VRM Class I, II, III or IV is located within the project area.

R-4: Location of VRM areas is available through VRM maps in land use plans located at the BLM office.

C-5: Visual resources will be affected profoundly by CBM development. This is evident from road building projections in the EIS, by the projections of numbers of wells--which mean wellpads and associated machinery, and by the increase in housing and other development that will occur as secondary results of CBM development. Why is there no discussion of the impact that the widespread alteration of the landscape will have on residents, tourism, and our economy in general? There is no discussion about the impact on the aesthetic qualities of the landscape that are generally associated with our state, such as wide open spaces, solitude, sounds of bird songs, and the opportunities this quiet landscape provides for reflection. Why weren't these issues considered in the DEIS?

R-5: Impacts on aesthetic and scenic qualities are discussed in the Visual Resources section of Chapter 4 of the Final EIS. Mitigation measures as described in Alternative E-Preferred Alternative of Chapter 2 and Table MIN-5 in the Minerals Appendix of the EIS will be used to minimize impacts to visual resources and the landscape in the area of CBM development. Impacts to solitude would be analyzed if the area was being considered for wilderness. Since none of the alternatives include a proposal for wilderness, impacts to solitude were not analyzed. Chapter 2 includes actions to mitigate noise.

C-6: We are concerned with the disruption of views that could result from the installation of CBM facilities such as wellheads, pump shacks, powerlines, and pipelines.

R-6: Impacts on aesthetic and scenic qualities are discussed in the Visual Resources section of Chapter 4 of the Final EIS. Mitigation measures as described in Alternative E-Preferred Alternative of Chapter 2 and Table MIN-5 in the Minerals Appendix of the EIS will be used to minimize impacts to visual resources and the landscape in the area of CBM development. Sight specific impacts would be analyzed at the APD and/or POD stage.

Wilderness Study Areas

Comments and Responses

Comment 1 (C-1): The DEIS touches only briefly on Wilderness Study Areas (WSA) within the planning area.

Response 1 (R-1): As CBM development will not be conducted in these areas, they are only touched on briefly.

C-2: The section on WSA is less than one page and does not constitute an analysis. Although there are restrictions on leasing in WSAs, it is clear from language in the EIS that increased development would result in increased access, via the increase in roads, to remote areas. Why are the impacts on WSAs not analyzed with more careful attention to the potential of CBM development to encourage increased access into these remote and sensitive areas?

R-2: The wilderness analysis is brief because these areas are not expected to be impacted by project activities. Remote areas may be accessed as CBM development proceeds, but this does not include WSAs.

Wildlife

Comments and Responses

Comment 1 (C-1): There is nothing in-depth about the Bozeman Pass area, and the document offers no adequate measures to mitigate these impacts.

Response 1 (R-1): The document discusses impacts from CBM development that may occur within Montana on a general scale. Impacts at specific locations will be analyzed when site-specific proposals are made.

C-2: Thorough fish and wildlife inventories are needed, which the EIS lacks.

R-2: This document intended to discuss impacts from CBM development that may occur over a large area of Montana. No specific areas have been identified for development. Therefore, studies at sites of actual CBM development are not possible at this time. The BLM will conduct detailed biological clearances and evaluations on specific projects when Project Plans are submitted for review and approval (see WMPP, Wildlife Appendix).

C-3: Gallatin Pass area is unique and requires thorough and separate analysis in the EIS.

R-3: See ***R-1***.

C-4: The pipelines and roads will affect nearly every species of wild game and fish populations in the areas where the wells are drilled.

R-4: The EIS provides an extensive discussion of the types of impacts that would be expected to affect a wide range of wildlife and fish species and their habitats.

C-5: The EIS does not adequately address the impacts of highly saline water on aquatic ecosystem and on streams and damage to wildlife habitat.

R-5: The EIS notes that substantially higher flows and degraded water quality would result in potentially substantial erosion of wetland and riparian communities and wildlife habitat degradation from higher SAR levels. Potential resultant effects on aquatic resources from exploration and development activities are discussed extensively in the EIS.

C-6: CBM development will lead to the drying of springs crucial for livestock and wildlife.

R-6: This impact is discussed. However, as stated in the Hydrology section of the EIS, shallow aquifers should be isolated from water withdrawal in deeper aquifers in many instances. This would minimize impacts on surface vegetation that is dependent on the shallow water table. Desertification should not be a widespread problem. An evaluation of impacts will be made for individual permit applications and measures taken to avoid or minimize impacts on sensitive vegetation and wildlife.

C-7: Many species will be harmed by the proposed action.

R-7: The EIS notes that impacts on wildlife will be widespread.

C-8: There is no meaningful analysis of the potential effects of development on vulnerable populations, and there is no discussion of adequate mitigation measures.

R-8: See ***R-1***. Also, the EIS discusses expected impacts on rare and sensitive species identified by State and Federal agencies. See the Wildlife Monitoring and Protection Plan (WMPP) in the Wildlife Appendix for additional inventory and monitoring commitments on the part of BLM and inventory, monitoring, avoidance and protection recommendations for operators. BLM will address impacts on vulnerable populations as part of their assessment of specific project applications. See biological opinion mitigation measures added to Alternative E in Chapter 2.

C-9: CBM water will create and enhance habitat for ducks, shorebirds and small mammals, as well as cattle.

R-9: The EIS notes that increased flows may result in improved and more extensive riparian vegetation in intermittent drainages where seasonal water stress limits the current extent or condition of the vegetation and in more widespread water availability for wildlife. The term wildlife is intended to cover a range of species that would use these habitat types. However, this benefit would be offset if more livestock grazing occurs in the vicinity and downstream of the discharge points.

C-10: Rural electric utilities have adopted construction techniques that are uniformly employed to eliminate risks of raptor electrocution.

R-10: The text was modified to reflect this, however it is further recognized that following raptor proof guidelines, threat of electrocution is not eliminated.

C-11: Full consideration of the habitat fragmentation on landscape scale evolutionary processes is not discussed.

R-11: See ***R-1***. Given that specific locations of CBM development are not known, it is not possible to address habitat fragmentation and landscape level evolutionary processes more fully than they have been addressed at this time. However, it is recognized in the document that direct and indirect impacts may effect up to 4.7 million acres of habitat (Table 4-41).The BLM has committed to addressing a full range of biological topics on specific projects when Project Plans are submitted for review and approval.

C-12: Loss of springs and wet meadows could impact many species.

R-12: See ***R-6***.

C-13: Creation of new "wetlands" could act as population sinks for many species, and the wildlife that try to use them may be more vulnerable to predators.

R-13: The comment is addressed in the EIS.

C-14: Changes in flow regime and sediment flow can negatively impact many species.

R-14: See ***R-5***.

C-15: How will clay-cemented surfaces affect everything from runoff and how would it affect use of the lands?

R-15: Soils of this type are poorly drained which can result in large volumes of water run-off and/or inundation of water. Ponded water would be available for wildlife use.

C-16: Accidental spills, leakage, run-off, leaching, drilling fluids, and other toxic substances pose a real threat to wildlife.

R-16: The comment is addressed in the EIS.

C-17: There is the problem of increasing traffic and its impacts.

R-17: The impacts of both roads and increased traffic are addressed in the EIS.

C-18: Invasive plants could affect hiding cover for some species, making them more vulnerable to predators.

R-18: The effects of noxious weeds and exotic plants on native vegetation and wildlife habitat and forage are discussed in the EIS.

C-19: There is no attempt to quantify the effect of thousands of miles of powerlines that will be built, providing new electrocution risks for birds of prey.

R-19: See ***R-1***. The number of miles of new powerlines are described in the EIS. Site-specific impacts cannot be determined because the locations of CBM development are not known. The BLM is committed to addressing a full range of biological topics on specific projects when Project Plans are submitted for review and approval.

C-20: The creation of numerous buildings, culverts, and other developments could lead to an increase in such smaller predators that could affect small prey species.

R-20: The new structures created by CBM could be preferred by several species, including some small predators.

C-21: An analysis of all potential prairie dog habitat should be completed prior to development.

R-21: Stipulations require avoidance of prairie dog towns larger than 80 acres to protect actual or potential black-footed ferret habitat if ferrets are found to be present. All prairie dog towns impacted by a federal action will be evaluated (see WMPP).

C-22: Potential impacts upon some species exist, yet no discussion is found in the EIS.

R-22: See ***R-1***. The discussion of impacts addresses a wide range of species and the types of impacts on wildlife and habitat that would be expected.

C-23: Winds could carry air pollutants into the higher elevations, which have granitic cores with poor buffering capacity and may suffer from acidification affecting fish populations, invertebrates, amphibians and other species. We found no mention of this potential impact in the document.

R-23: Acid deposition is being addressed in recent air modeling and is reported in the EIS. If this is found to be a potential problem, it will be addressed in the Aquatics section. See Air Quality (Chapter 4 and Air Quality Appendix).

C-24: Any shift in habitat utilization or intensity of use by livestock as a result of CBM development has the potential to lead to negative impacts on wildlife not directly the result of CBM development.

R-24: Changes in livestock use as a result of increased water availability because of CBM development and the effects on wildlife and habitat were addressed in the EIS. The EIS states, " Each CBM production well field that is located in an area without perennial water sources could make up to several thousand acres available to more intensive cattle grazing. Utilization would be most intensive in the immediate vicinity of the water discharge location wells. Increased livestock grazing reduces forage otherwise available for wildlife and degrades habitat value for many species of wildlife (Saab et al. 1995). The additional CBM water would also be available for wildlife use."

C-25: The EIS appears incomplete with respect to fish and wildlife issues without documenting any correspondence or data offered by regional biologists.

R-25: The nature of this document, the large area over which impacts may occur, and the lack of knowledge on specific impact locations substantially reduced the need for site-specific biological data. However, the species that occur on lands and in water bodies located over the widespread coal beds in Montana were addressed along with expected impacts on those species and their habitats. Regional agency data bases that describe aquatic species composition, abundance, and habitat characteristics were used to describe the affected environment and assess potential project effects in the EIS. Federal and State biologists were consulted on a regular basis during preparation of the EIS.

C-26: The EIS refers to impacts on gray wolf populations but does not provide any conservation measures. The loss of wolf individuals or loss of designated habitat resulting from any implementation of a CBM project is in violation of the ESA and may be considered an illegal taking. The EIS makes no mention of the future delisting of the gray wolf and Montana's proposed management plan.

R-26: The BLM conduced formal Section 7 consultation with the FWS for all proposed, candidate, and listed species during the preparation of this document. Appropriate conservation measures to reduce or avoid impacts will be developed for each project plan. (Refer to WMPP, BA and BO in the Wildlife Appendix).

C-27: Table 4-16 refers to Peregrine falcon nests. The proper term is eyrie (or aerie) and not nest.

R-27: The text was changed to reflect the comment.

C-28: The Wildlife section of Chapter 4 states that there will be no surface use related to CBM exploration within 0.5 mile of active nest sites during critical periods of time. The 0.5-mile zone is commonly used when there is no line of sight to the nest. The stipulation should state 1 mile if there is line of sight and if there is no line of sight. These distances should be the distance from the perimeter of the disturbance. Certain avian species require 1 and 2 mile distances, respectively.

R-28: The EIS recognizes that the 0.5-mile restriction will not protect all nesting raptors. Changing lease stipulations beyond the scope of this document (pg 2-2). However, additional management actions to mitigate impacts from CBM activities on raptors and other species provided in the Wildlife Protection and Monitoring Plan (WMPP, Wildlife Appendix) may be implemented on a case-by-case basis as needed.

C-29: Is the 0.25-mile buffer stipulation provided for wetlands identified as piping plover and least tern habitat sufficient? Does the 0.25-mile refer to the well distance from the wetlands or the distance from the perimeter of the actual disturbance?

R-29: The 0.25 mile buffer is assumed to be sufficient. The quarter-mile restriction for least tern and piping plover would extend from the edge of the occupied wetland to the nearest surface disturbance associated with CBM development.

C-30: If a "may impact" conclusion is reached after suitable analysis by a Biological Assessment, then formal consultation with the FWS is mandated and suitable conservation measures (not mitigation measures) are required to be developed.

R-30: See ***R-26***.

C-31: In Chapter 4, the section BLM, U.S. Forest Service (USFS), and Montana Species of Concern states that sage grouse will be impacted by CBM activities occurring within 2 miles of a lek or winter range. The sentence should state that sage grouse populations will be reduced or eliminated by CBM activities.

R-31: We agree that impacts on sage grouse would be observed at the population level, and the text was modified to reflect this.

C-32: The noise generated by compressor stations has been compared to the noise generated by jet engines. Studies exist that detail stress impacts on wildlife and subsequent habitat avoidance related to jet aircraft noise.

R-32: The EIS recognizes that noise will disturb wildlife and eliminate some species from very noisy areas. However, there is a 50 decibal limit on production facilities at a distance of 1/4 mile that will mitigate these impacts at greater distances.

"Other noise-related problems for birds around CBM exploration and production wells and compressors include interference with the ability to recognize warning calls and calls by juveniles. The area of disturbance would vary by species and CBM activity. Producing wells would be relatively quiet once regular production is underway. Compressors would be louder with noise levels at 50 decibels at a distance of 0.25 mile."

C-33: No mitigation measures are offered for roads constructed across wetlands and the subsequent loss of wetland habitat. Was the Corps of Engineers ever contacted for input during the development of the EIS?

R-33: Impacts on site-specific wetlands and riparian areas will be identified when a site-specific project is proposed. If appropriate, the Corps of Engineers will be consulted regarding Section 404 Permits. Wetland impacts will be determined at the time individual applications are reviewed. The 404 Permit will include required avoidance and mitigation measures. The Corps of Engineers was provided copies of the DEIS for review.

C-34: Waterfowl are protected under the Migratory Bird Treaty Act and therefore should be addressed in the EIS.

R-34: See ***R-1***.

C-35: An ongoing study and reporting is needed on disturbances to both domestic animals and wildlife and plants in the area. The ecosystem needs to be monitored.

R-35: The BLM is fully committed to determining impacts from specific CBM projects when Project Plans are reviewed. Appropriate site-specific studies and clearances will be conducted at that time and mitigation measures will be developed and required. See ***R-8***. The WMPP, in the Wildlife Appendix, includes the following provision regarding inventory and monitoring: "During project development (i.e., 25 years), operators will provide an updated inventory and description of all existing project features (i.e., location, size, and associated level of human activity at each feature), as well as those tentatively proposed for development during the next 12 months. This inventory will be submitted to the BLM by operators no later than October 15 of each calendar year. These data will be coupled with annual wildlife inventory, monitoring, and protection data obtained for the previous year and included in annual reports. Annual reports will be prepared by the BLM.

"When annual wildlife inventory, monitoring, and protection data are gathered by parties other than the BLM, those parties (e.g., operators, MFWP) will be requested to provide the data to the BLM by October 15 of each calendar year. Upon receipt of these data, annual reports will be completed in draft form by the BLM and submitted to the operators, FWS, MFWP, and other interested parties no later than November 15 of each year. A 1-day meeting of the *Team* and *Core Team* will be organized by the BLM and held in early December of each year to discuss and modify, as necessary, proposed wildlife inventory, monitoring, and protection protocol for the subsequent year. Additional meetings specific to a Regional Monitoring Unit (RMU) will be scheduled as necessary."

C-36: Will there be penalties for "accidents"? Will CBM companies be required to clean up their accidents and who will enforce that this cleanup is done in a timely way?

R-36: Penalties are assessed for accidents under the existing oil and gas regulations and operators are required to immediately clean up spills according to their Spill Prevention Control and Countermeasures Plans. Enforcement is based on jurisdiction, but in the majority of cases it would be either the EPA or MDEQ. See the Solid and Hazardous Waste section in Chapter 4 for more detail.

C-37: The absence of a Flora/Fauna study effectively disqualifies any meaningful analysis of effects to agriculture and recreation due to impacts on forage, game and non-game wildlife associated with CBM development. Because of the absence of this data, the EIS does not allow the opportunity for public comment on an important aspect of the analysis.

R-37: See ***R-1***. The EIS discusses the types of plant communities that occur in potential CBM areas and addresses potential impacts on these lands. Habitat effects are also discussed at length.

C-38: An obvious deficiency in the EIS is the omission of several species of special concern.

R-38: All species of concern identified by state and federal agencies. that may occur in the project area and are classified "S1" or higher, are addressed in the Wildlife Appendix.

C-39: The EIS focuses primarily on species occurring within the planning areas but does not address their natural history strategies or the chemical and physical conditions that support these organisms.

R-39: Wildlife species and their habitat needs are addressed in the wildlife section of Chapter 3, the BA and the BO (Wildlife Appendix).

C-40: The EIS fails to recognize the high biological integrity and ecological value of the Powder River.

R-40: The Powder River and its tributaries were discussed extensively in Chapter 3 under the heading Powder River RMP Area. Discussions focused on the composition and abundance of different fish species in these drainages, fisheries management objectives, and characterizations of drainage conditions. This information was presented in text and summary tables in the EIS. Chapter 4 of the EIS analyzed potential project effects on aquatic resources and habitat. It identified drainages that might be most affected by CBM development and the sensitivity of those drainages to potential impacts. Those discussions considered Powder River drainages.

C-41: There is no analysis of the cumulative effects, considering the existing development in Wyoming on wildlife resources, which of course do not recognize administrative boundaries.

R-41: The EIS states, "Impacts from Wyoming CBM development on wildlife and wildlife habitat would be similar to those described under Alternative A, but at a far larger scale. More than 7.5 times as many CBM wells may be developed in the Powder River basin of Wyoming than the 18,275 considered under Alternatives B, C, D, and E. The magnitude of direct and indirect Wyoming CBM impacts on wildlife and wildlife habitat would be about 7.5 times greater than described for Alternatives B, C, D, and E.

C-42: The analysis does not adequately disclose the effects of CBM development on private lands where industry would not be responsible for providing compensation for the loss of wildlife and/or wildlife habitat.

R-42: The Minerals Appendix indicates those mitigation measures that may be implemented on state or federal lands. The text has been modified to clarify that these measures would not apply to private lands and that additional impacts would occur on private lands. However, mitigation measures and conditions of approval will apply to private lands that are being developed for federal minerals.

C-43: The effects analysis does not adequately disclose the impact of the wastewater generated by CBM development on wildlife relative to aquifer recharge and the contamination of surface waters. Further, the analysis dismisses the serious consideration of an alternative that would feature "re-injection" of the water produced by CBM wells.

R-43: The EIS recognizes that there are water quality issues associated with CBM water. The preferred alternative does not allow reinjection of this water into the aquifer to avoid contamination and it requires that all surface water be treated to meet Montana water quality standards prior to discharge.

C-44: The analysis is flawed in regard to its assumption that the water created through the extraction process would benefit wildlife. The analysis does not include data to indicate where or how much water would benefit wildlife resources.

R-44: See ***R-24***. The EIS also states, "The release of untreated CBM water to surface drainages and streams could result in serious erosion, damaging or destroying instream and streambank riparian vegetation that constitutes valuable wildlife habitat (Regele and Stark 2000). The erosion can result in increased sediment loads, increased SAR values, which along with the potential high salinity, can degrade the stream and impact riparian vegetation."

C-45: Given the premise that wells will be sited at varying spacings, to comply with MBOGC regulations, what mitigation measures do you propose? For different species?

R-45: All wildlife management actions are made with the assumption of maximum well spacing.

C-46: Table 4-38 of the DEIS estimates possible road densities for the different alternatives. Are the BLM and the State of Montana going to wait until sage grouse are listed before taking action to protect sage grouse habitat? What impact do you expect on such species as the burrowing oil and the mountain plover? What about other species of birds that are sagebrush obligates?

R-46: The assumption is made that existing stipulations will provide some protection to sage grouse habitat including lek areas, nesting habitat and winter range. It is recognized that these actions will not completely protect this species. Mitigation measures within the Wildlife Monitoring and Protection Plan (WMPP) will provide additional protective measures. Lease stipulations and terms and conditions will provide protection to raptors and the mountain plover. Protective measures contained in the WMPP (if fully implemented) will help reduce, but cannot avoid all, impacts to all species of wildlife including sagebrush-obligate birds.

C-47: Stipulations in Table MIN-5 of the DEIS protect wildlife, however, Table 4-16 (DEIS) states that the stipulation "does not apply to operations and maintenance of production facilities." Operation and maintenance constitutes the greater amount of activity. How do you reconcile these differences?

R-47: We agree that operation and maintenance pose threats to wildlife. However, if conditions of approval are consistent with the WMPP and terms and conditions of the BO, this will help reduce or avoid some impacts associated with operation and maintenance.

C-48: The present baseline data are totally inadequate to allow an adequate evaluation of the potential impacts on sage grouse in the area. The entire discussion of indirect and cumulative effects of CBM development on sage grouse is inadequate. There is almost no discussion of mitigation for habitat loss or direct impacts of CBM development on sage grouse.

R-48: See ***R-1***. Impacts on sage grouse were discussed in detail and impacts were projected to occur on several million acres. Proactive management for sage grouse and other species is offered, but not required at this time, in the WMPP (Wildlife Appendix).

C-49: The EIS uses minimal distances such as 0.25 mile for no disturbance during the breeding season. This "magic" number has been created by the BLM without any scientific basis and contradicts published guidelines dating to 1977 (Braun et al. 1977) and more recently (Connelly et al. 2000). Further, the BLM has publicly accepted the published guidelines and has promoted use of selected recommendations. This selective use of the published literature has been done despite clear evidence that sage-grouse are negatively impacted by disturbance activities.

R-49: The EIS cites these same references and recognizes that the stipulations are not adequate to avoid impacts on sage grouse. The text states, "Therefore, while important, protecting a 0.25-mile radius area around leks as specified in the stipulations, is inadequate to avoid impacts on displaying and nesting birds." Although there are additional lease stipulations that offer protection to sage grouse nesting and wintering areas during exploration activities, it is recognized there would be impacts associated with production and maintenance activities. However, protective measures may be developed at the project plan level and incorporated as "Conditions of Approval" (See WMPP).

C-50: Surface disturbance leads to the spread of noxious weeds. The long-term repercussions that noxious weeds have on native wildlife populations are devastating and well documented.

R-50: We agree and have stated so in the document. See ***R-18***.

C-51: Community relationships among these species were not analyzed. While the EIS indicated that subsequent site-specific compliance documents will do this, the alternatives proposed in this EIS do not analyze or consider the cumulative impacts that will result from widespread community disruption and destruction.

R-51: Landscape-scale as well as cumulative impacts were analyzed in the document.

C-52: CBM development will have severe impacts on ferruginous hawks because of the increased human presence, disturbance, and noise; these impacts were not acknowledged nor were mitigations suggested in the EIS.

R-52: See ***R-28***. The ferruginous hawk has a NSO stipulation for 1/2 mile from a nest and additional protective measures within the WMPP. However, this is one of the species that is very sensitive to human activities discussed in Chapter 4, Wildlife, and all impacts would not be avoided.

C-53: Sage grouse are a possible candidate for listing under the ESA.

R-53: We agree.

C-54: The Affected Environment in Chapter 3 does not describe the array of habitats present in the area that will be fragmented, destroyed, or otherwise altered by this massive development. No studies were done or referred to that describe the array of habitats critical to all wildlife, but in particular, those threatened, endangered, and state-listed species of special concern.

R-54: The array of habitats, including fragmentation and disturbance is discussed in the EIS. Additionally, special status species are discussed in the EIS text, Biological Assessment and Opinion.

C-55: Why does the EIS not recognize and discuss the cumulative effects that this project will have on native neo-tropical migratory birds and game birds?

R-55: See ***R-1***. Neo-tropical migrant birds are one group of wildlife that would be affected by CBM development, as described in the EIS. Because of the nature of the document, many individual species were not addressed. However, the types of impacts that would affect all wildlife were discussed at length.

C-56: Providing a thorough laundry list of the types of impacts expected to be generated by CBM methane development is insufficient for NEPA purposes. In addition, the BLM is responsible for quantifying the magnitude of those impacts.

R-56: See ***R-1***. Given the nature of the document and the lack of specificity regarding impact sites, the EIS quantified impacts where this was possible. The lengthy discussion of the types of impacts that would be expected and the types of species and habitats affected is quite appropriate for an EIS. As stated in the EIS, the BLM is committed to conducting appropriate site-specific analyses of Project Plans as they are submitted for review.

C-57: Authors of the EIS conclude that "direct and indirect impacts on wildlife from this scale of development would be both widespread and substantial.

R-57: While it is apparent wildlife impacts may be substantial, measures such as the WMPP and Terms and Conditions of the Biological Opinion will help lessen these impacts for some species.

C-58: After listing multiple sources of stress, little qualitative, and no quantitative, analysis is conducted. There is no analysis of the possible cumulative or synergistic (combined effects are greater than the sum of the parts) effects that can arise from multiple stressors acting simultaneously on a wildlife species.

R-58: We agree that this type of analysis is required before CBM development proceeds. However, without knowledge of specific actions it is not possible. As stated in the EIS, the BLM is committed to conducting appropriate site-specific analyses of Project Plans as they are submitted for review.

C-59: Chapter 4 focused almost exclusively on the area of habitat expected to be impacted by CBM development. In no case was there an attempt to relate the amount of habitat listed to the expected change in population distribution for any species. Equally important is an estimate of how the spatial distribution of the habitat will change following CBM development.

R-59: The analyses you request would be conducted by the BLM as specific Project Plans are reviewed.

C-60: CBM well disturbance at a given site is temporarily put on hold to protect a sensitive species for a relative short time interval during a given year. After that interval, the activity can proceed, leading to temporary or long-term habitat loss.

R-60: There is variability within present lease stipulations that offer protection from permanent to seasonal. Measures within the WMPP will offer additional protection to sensitive species. It is recognized that all impacts cannot be avoided.

C-61: Why are the State and the BLM taking the position of waiting until a known sensitive species, sage grouse for example, is formally "listed" as "endangered" or "threatened" before taking a position to protect that species? The EIS is defective and unacceptable because of this omission.

R-61: See ***R-46 and R-48***.

C-62: A principal component of Alternative E (Preferred Alternative) must include a habitat management goal of no net loss of sagebrush steppe to maintain sage grouse and other wildlife species dependent on this habitat requiring reclamation of disturbed lands, rights of way to include replacement of the original shrub component to provide habitat fragmentation.

R-62: The BLM's policy requires reclamation of disturbed lands, not restoration of habitats present before disturbance. There is no requirement to specifically re-establish native grasses, forbs, or shrubs, although these species may be included in seed mixes. The EIS states, "The intent of reclamation is to re-establish a vegetative cover on disturbed areas rather than to restore native plant communities, as they existed prior to disturbance. Plant species diversity would be lower on reclaimed sites than before disturbance, reducing overall wildlife habitat values." Sagebrush is characteristically very difficult to establish, however creative approaches to reclamation are suggested in the WMPP and the species will be a focus.

C-63: The gaps in wildlife baseline biological studies inadequately address the impact full field development will have on wildlife. We recommend a phased development plan.

R-63: See ***R-1*** and ***R-28***, and the Wildlife section of Chapter 4 in the FEIS.

C-64: There is no mention of small-mouth bass in the Tongue River, which is the major game fish below the Tongue River Reservoir.

R-64: The EIS discusses the occurrence of small-mouth bass in the Tongue River and its prominence downstream of Tongue River Reservoir.

C-65: Alternative E (Preferred Alternative) states, "Operators would … how impacts on surface resources, such as wildlife, would be minimized." It is recommended that the word "inventoried" be inserted before wildlife, so that actual wildlife use of the area is addressed.

R-65: The text has been changed to reflect the comment.

C-66: The sage grouse stipulations in Table 4-16 of the DEIS have been used to effectively protect sage grouse and there is no evidence of sage grouse incompatibility with natural gas production.

R-66: We were unable to locate any published literature indicating that widespread CBM development and sage grouse are compatible over the long term. Substantial documentation is cited in the EIS that various types of disturbance and activities associated with CBM development (roads, powerlines, noise, human activity, etc.) are not compatible with long-term sustainability of sage grouse populations. However, with implementation of lease stipulations and measures in the WMPP impacts to sage grouse may be lessened.

C-67: Why has specific data not been included about impacts on the Yellowstone River, on the pallid sturgeon population in the Yellowstone River, on the paddlefish population, and the potential economic impacts on the Glendive Chamber of Commerce's paddlefish caviar operation? Where is the study of the plant, animal, and fisheries inventories on the lower Yellowstone River?

R-67: See ***R-1***. Fish, wildlife, and plant populations and impacts were presented in their respective appendices and in the Chapters 3 and 4 text. Additionally, the pallid sturgeon is discussed in the Biological Assessment and Opinion.

C-68: Why does Alternative E (Preferred Alternative) have no mitigating measures to protect wildlife? Chapter 4, Table 4-19 (DEIS), states impacts on wildlife under Alternative E are the same as under Alternative C, which emphasizes CBM development with minimal resource protection.

R-68: Impacts to wildlife under Alternative E are similar to those described for C , however, there are many measures offered in Alternative E that will substantially reduce impacts to wildlife. See the Wildlife Monitoring and Protection Plan and Biological Opinion located in the Wildlife Appendix for these protective measures.

C-69: The BLM, and their non-federal representatives should work with the Service in developing surveys, impact minimization measures, and conservation measures for all federally listed species.

R-69: The BLM completed formal consultation with the US FWS concerning all listed species within the planning area. See discussion within the Biological Assessment and Biological Opinion located in the Wildlife Appendix.

C-70: The federal status for the black-footed ferret should be E/10(j) because there is a non-essential experimental population in Blaine County.

R-70: The text has been changed.

C-71: Because domestic dogs can pose a threat to mountain plover nests and flightless chicks, dogs should not accompany BLM employees, operators, and sub-contractors in their vehicles on-site during working hours.

R-71: As specified in the WMPP in the Wildlife Appendix, the BLM will develop an information and education program to inform operators about sensitive species and habitats before exploration and development begins. Additionally, dogs and sensitive species management are addressed in the Biological Assessment and terms and conditions of the Biological Opinion.

C-72: Why do the EIS alternatives, in particular Alternative E—Preferred Alternative, not provide detailed development scenarios and mitigation capable of reducing detrimental impacts on the diverse public fish and wildlife within the described area nor ensure the long-range viability of existing populations?

R-72: Potential development scenarios are presented in the document. The preferred alternative offers lease stipulations, protective measures provided in the WMPP and terms and conditions of the Biological Opinion intended to reduce, but not avoid, all impacts on wildlife.

C-73: Why does the EIS lack consideration, mitigation, for the continuance of historically legitimate-traditional hunting and fishing opportunities?

R-73: Impacts on hunting opportunities were addressed in the EIS. No mitigation of these impacts is proposed at this time.

C-74: Why would activities be allowed within 0.25-mile of sage grouse leks knowing activities and noise from compressors will disrupt reproductive habits and, consequently, populations?

R-74: No surface occupancy is allowed within 0.25 mile of sage grouse leks. Additionally, there is noise restrictions for compressors and other mitigation measures offered in the WMPP.

C-75: Why is there no provision for "no net loss" of sagebrush-steppe habitat that is necessary for viable populations of sage grouse and other non-game species?

R-75: See ***R-62***.

C-76: How can Alternative E promote, "no degradation of a watershed would be allowed" without predetermined water quality standards taking into consideration cumulative effects or discharge water treatment?

R-76: Montana DEQ narrative water quality standards will be followed. See Chapter 4, Hydrology, for details.

C-77: Why is it that, "... wintering and nesting sage grouse and nesting golden eagles would not be protected by stipulations and would be expected to suffer large-scale impacts"?

R-77: Existing lease stipulations do provide protection to winter/nesting sage grouse and nesting golden eagles. Also, it is expected that implementation of the WMPP may provide additional protection to these species where the WMPP provisions are applied.

C-78: Why is the small-mouth fishery, rated as excellent in Montana Fish, Wildlife and Parks literature, not a listed species in the tables for the Tongue River?

R-78: See ***R-64***.

C-79: Why are there no studies or mitigation relative to the loss of aquifers that sustain surface vegetation required for sustenance and cover for a diversity of wildlife?

R-79: As stated in the EIS, shallow aquifers should be isolated from water withdrawal in lower aquifers in many instances. This would minimize impacts on surface vegetation that is dependant on the shallow water table. Desertification should not be a widespread problem. An evaluation of impacts will be made for individual permit applications and measures taken to avoid or minimize impacts on sensitive vegetation.

C-80: What exactly are the "limits on available biological information"?

R-80: Most data regarding biological populations is very site specific, rendering it of little use in a document of this type. Therefore, the analysis focused on the types of habitats that would be impacted and the types of impacts on wildlife that would be expected to occur.

C-81: Why have "appropriate surveys conducted prior to construction" not been done prior to publishing this short-sighted document?

R-81: See ***R-1***, ***R-35***, and ***R-69***.

C-82: The EIS should assess the appropriateness of using oil and grease results in determining impacts on fish and wildlife resources.

R-82: Oil and grease results are not being used to assess impacts on fish and wildlife resources. See Chapter 4, Wildlife.

C-83: In the Monitoring Appendix of the DEIS, diversity as well as population density would need to be measured.

R-83: We agree, impacts on species diversity will be addressed by BLM when individual applications are reviewed.

C-84: Where is the analysis of the impact of increased mosquito populations and the cumulative impact on wildlife and human health resulting from the mosquito infestations that will occur along with and the likely spraying to eliminate them?

R-84: Mosquito populations have not been shown to increase as a result of CBM development and therefore are not addressed in the EIS.

C-85: There is no analysis of the impact of standing water on bird migration.

R-85: This topic has been addressed in the EIS.

C-86: Will threatened or endangered species be relocated before the flooding takes place?

R-86: Site clearances for sensitive, threatened, and endangered species will be required before all surface disturbance or flooding. If such species or their habitat are located, appropriate conservation measures to avoid impacts will be required.

C-87: Likely result in the loss of fish populations as a result of the loss of the food base. These impacts have not been adequately addressed in the EIS.

R-87: Numerous potential effects on the prey base are discussed at the level appropriate for an EIS. The likelihood of substantial effects on all aquatic resources and their habitat from project exploration and development activities are described.

C-88: There is no baseline data in some instances.

R-88: See ***R-1***.

C-89: Would like to see a more clear demonstration in the FEIS that the land in the project area "will provide food and habitat for fish and wildlife" consistent with FLPMA's general provisions and that such habitat can be reclaimed adequately to support wildlife populations post-drilling.

R-89: The BLM's policy requires reclamation of disturbed lands, not restoration of habitats present before disturbance. There is no requirement to specifically re-establish native grasses, forbs, or shrubs, although these species may be included in seed mixes. See ***R-62***. Because of differences in plant species composition, reclamation of disturbed lands will result in habitats that support certain wildlife species rather than all wildlife species present before development.

C-90: The NSO stipulation buffers should be extended to a 2-mile (3.2-kilometer) radius around any active leking area. For migratory populations, the buffer may need to extend 18 kilometers for leks to ensure nest sites are protected. This buffer should also exclude powerlines from the area.

R-90: The EIS is a development document, not a leasing document and any changes to stipulations are not included.

C-91: The plan has no alternative that considers prohibiting surface use from March 1 to June 15 for all activities (including operation and maintenance), burying powerlines, minimizing noise from compressor stations and well pumps, or reinjecting production water.

R-91: The standard lease terms, as stated earlier, can be used to reduce or avoid impacts of concern during operations and maintenance. The Wildlife Monitoring and Protection Plan contains many measures that could be proposed by the operator or imposed by the BLM if justified. However, these provisions are not required at this time. Alternative E includes burying pipelines near sage grouse habitat and noise reduction measures. Reinjection is included in Alternative B.

C-92: The EIS fails to adequately analyze how new roads will influence vulnerability of formerly inaccessible wildlife to hunter harvest.

R-92: The EIS states that impacts on wildlife would be widespread. One of these impacts is, "the increased access provided by both CBM and user-created trails and roads over the span of all CBM phases and beyond, which would result in additional legal harvest and illegal poaching of game animals (Cole et al. 1997), target shooting of animals such as prairie dogs and other similar species (Ingles 1965), and chasing and harassing of animals (Posewitz 1994, USDI and USDA 2001)." Since no specific sites have been identified for CBM development, it is not possible to assess the effects of new roads and increased access on the vulnerability of specific populations of inaccessible wildlife to hunter harvest. The BLM is fully committed to determining impacts from specific CBM projects when Project Plans are reviewed. Appropriate site-specific studies and clearances will be conducted at that time and mitigation measures will be developed and required.

C-93: The EIS states the exploration activities would temporarily displace game species and production facilities would reduce the number of game animals or force animals to move from the area, but the document offers no adequate measures to mitigate these impacts.

R-93: Current lease stipulations offer some degree of protection to certain species during exploration activities. The WMPP offers measures that may help reduce impacts during critical time periods.

C-94: From Chapter 4, Wildlife Assumptions: Please consider subsistence use of and dependence on wildlife in the impacts and mitigation discussion for the Northern Cheyenne.

R-94: This has been addressed in the EIS.

C-95: Regarding the Tongue River Reservoir, how would this fishery be impacted?

R-95: No projects have been identified, therefore specific impacts on the reservoir cannot be assessed. However, under the Preferred Alternative, the operator is required to develop a Water Management Plan that demonstrates how they will dispose of their disposed water without degrading surface water bodies. Furthermore, an agreement between the states of Wyoming and Montana has been reached that ensures the quality of the water reaching the Tongue River Reservoir from Wyoming meets Montana's standards.

C-96: Has the BLM given any thought to the impact spreading or new fires would have on vegetation or wildlife (endangered species)?

R-96: The EIS notes that both CBM activity and unrelated human activities occurring along CBM roads or in formerly inaccessible areas that are opened to vehicle and ORV traffic because of CBM roads will likely result in an increase in wild fires.

C-97: Table 4-16 of the DEIS states that in order for prairie dog colonies to be potential black-footed ferret habitat, they need to consist of an appropriate burrow density in addition to size.

R-97: We agree, but the table lists current stipulations, and size as the first criteria of dog towns is the most important.

C-98: Table 4-16 of the DEIS appears to be incomplete. Mountain plovers are not on the list, but there is a stipulation described in the text. Also, there are stipulations for gray wolf, Canada lynx, and grizzly bear that are not included in the table.

R-98: The table includes current stipulations already in place. Mitigation measures for the mountain plover, lynx, gray wolf and grizzly bear are provided in the WMPP. Additionally, specific actions are required as terms and conditions in the Biological Opinion for mountain plover.

C-99: Chapter 4, Impacts From Management Specific to Each Alternative, states, "Grouse are particularly susceptible to collision mortality during the spring because they often fly to and from leks near the ground." This statement needs to be supported by a literature citation.

R-99: Sage grouse rarely fly very high off the ground, based on personal observation.

C-100: Chapter 4, Impacts From Management Specific to Each Alternative, states, "Roads displace animals from otherwise useable habitat." This sentence should be more specific. Roads do not displace all animals. They may displace some big game species.

R-100: The text was revised to reflect that not all species are displaced by roads.

C-101: Chapter 4, Impacts From Management Specific to Each Alternative, states, "These factors contribute to reduced over winter survival for individuals, poor condition entering the breeding season, reduced reproductive success and recruitment, and eventually population declines." Need a literature citation.

R-101: Citations have been added.

C-102: Chapter 4, Impacts From Management Specific to Each Alternative, states that while some raptor species are threatened, endangered, or species of concern, ravens are none of these. Ravens should be removed from this discussion.

R-102: This discussion is not related to threatened and endangered species.

C-103: Chapter 4, Impacts From Management Specific to Each Alternative, states, "Chronic physiological stress on wildlife can result in increased sickness, a decrease in individual productivity, and eventually result in population declines." While this may be true, there is no evidence that CBM development will lead to these events.

R-103: Substantial documentation is cited in the EIS about that the types of disturbance and activities associated with CBM development (roads, powerlines, noise, human activity, etc.) that result in chronic physiological stress in sensitive wildlife species can result in increased sickness, a decrease in individual productivity, and eventually result in population declines.

C-104: In Chapter 4, Impacts From Management Specific to each Alternative for Mountain Plover, it states that empirical evidence is lacking that shows whether or not exploration or development impacts the mountain plover. In fact, the mountain plover is a species commonly associated with disturbed grasslands. Therefore, exploration and development may create suitable mountain plover habitat.

R-104: We agree that mountain plover are a species of short grass, even disturbed sites, but we stand by this statement. This species can be disturbed from their nesting by human activity. The FWS recommends avoiding nesting plovers in order to help ensure successful nesting attempts See terms and conditions contained in Biological Opinion (Wildlife Appendix).

C-105: Chapter 4, BLM, USFS, and Montana Species of Concern, it states, "Eustace attributes this decline …" This is an improper citation of Eustace.

R-105: Eustace made this statement concerning sage grouse population declines in southeastern Montana directly to the author of the Wildlife section.

C-106: In Chapter 4, BLM, USFS, and Montana Species of Concern, it states, "… and may nest within 660 feet of their previous year's nest (Gates 1983, Lyon 2000)." This 660-foot distance is from Gates 1983 and is based on three birds that nested within this distance of the previous year's nest. Other studies such as Lyon 2000, Fischer 1993 et. al., and Berry and Eng 1985 found average distances of 683 meters (2,240 feet), 740 meters (2,427 feet), and 552 meters (1,811 feet) respectively.

R-106: The text has been modified to reflect this additional information.

C-107: In Chapter 4, BLM, USFS, and Montana Species of Concern, it states, "Therefore, while important, protecting a 0.25-mile radius area around leks as specified in the stipulations, is inadequate." There is no empirical evidence that shows that the 0.25-mile buffer is not adequate to avoid impacts on sage grouse leks. The 2-mile controlled surface use buffer around sage grouse leks is intended to protect nesting habitat during the nesting season. There is no empirical evidence that shows that this 2 mile buffer is not adequate. There is no empirical evidence that shows the CBM activity within 2 miles of sage grouse leks or within winter range will have an impact on sage grouse in the area.

R-107: The statements in the text are based on the guidelines to manage sage grouse populations and their habitats by Connelly et al. (2000). These guidelines are based on extensive literature that indicates that sage grouse are very sensitive to activity near the lek and that many birds nest beyond the 2-mile radius specified in the stipulation.

C-108: In Chapter 4, Species of Concern Mitigation Measures, Black-tailed Prairie Dog,, it states, "No mitigation measures are proposed for this species." Table 4-16 of the DEIS indicates that there is a controlled surface use stipulation on prairie dog colonies greater than 80 acres in size.

R-108: Yes, that is correct. Stipulations are for black-footed ferret habitat and exceed 80 acres.

C-109: Chapter 4, Alternative E, Species of Concern, states, "All species of concern that are not federally protected would be impacted…" It is important to also consider the potential benefits of creating a mosaic of habitats, site-specific water quality, surface disturbance, technology and the resulting diversified habitats across the landscape. This conclusion is not consistent with existing data on water quality hydrology and wildlife data.

R-109: The mosaic would consist of suitable native habitat and unsuitable disturbed and reclaimed areas. Such a mosaic (especially in shrub-steppe and short grass prairie) is usually prime habitat for invasive species, predators, and nest parasites. Breaking up large intact blocks of habitat will eliminate use by species that require larger patches.

C-110: Page MON-15 in the Monitoring Appendix of the DEIS, first column, first paragraph: The EIS also applies to conventional oil and gas as well as CBM.

R-110: The text has been changed to reflect the comment.

C-111: Page MON-15, first column, first paragraph (DEIS): "A site specific plan … will be required as part of each Project Plan." Each of the permitting agencies, dependent on the ownership of the mineral and/or surface estate may not have the statutory authority to require such a "site specific plan."

R-111: We recognize this, which is reflected in differences in the Minerals Appendix and the fact that impacts on private lands would be greater than on BLM lands. The WMPP (in the Wildlife Appendix) indicates those lands to which it would apply.

C-112: Page MON-15, first column, seventh bullet (DEIS): "Provide a mechanism for a rapid response to change environmental conditions." The purpose of the WMPP is to provide a process for monitoring and mitigating impacts associated with oil and gas activities, not to change environmental conditions.

R-112: We agree and this is reflected in the WMPP in the Wildlife Appendix.

C-113: Page MON-15, first column, eighth bullet (DEIS): Purpose of the WMPP is not to "validate predictive models" but to assess assumptions made in the EIS and to revise the applicable projections.

R-113: We agree and this is reflected in the WMPP in the Wildlife Appendix.

C-114: Page MON-15, second column, third bullet (DEIS): "Locate storage facilities, generators and holding tanks outside the line of sight of important sage grousing breeding habitat." There is not any data that demonstrates that "line of sight" is an issue with sage grouse breeding habitat. Also, whose "line of sight"?

R-114: "Line of sight" is commonly used terminology for wildlife mitigation measures. Topographical influences are also commonly used for wildlife mitigation purposes (see WMPP, Wildlife Appendix). In this case, "line of sight" refers to a facility being visible from sage grouse habitat.

C-115: The EIS failed to include information about wildlife species' current population or distribution, the status of the population trend, or the location of any important habitat areas. The EIS does not indicate where Management Indicator Species are, nor if they will be directly, indirectly, or cumulatively affected.

R-115: See ***R-1***. The BLM is fully committed to collecting and evaluating information about wildlife species' current population or distribution, the status of the population trend, the location of any important habitat areas, and the presence of Management Indicator Species when specific Project Plans are reviewed. Impacts of proposed actions will be fully documented when Project Plans are reviewed. Appropriate site-specific studies and clearances will be conducted at that time and mitigation measures will be developed and required.

C-116: The EIS fails to mention wildlife connectivity and corridors. Migration corridors are mentioned for waterfowl (3-75), but not for wide-ranging wildlife species. This assessment should emphasize corridor use of both MIS (i.e., elk) and TES species. The cumulative intrusion of past and future development in the area and impacts related to drilling and full-scale development to functioning corridors should be evaluated.

R-116: See ***R-1***. The BLM is fully committed to collecting and evaluating information about wildlife species' migration corridors when Project Plans are reviewed. Appropriate site-specific studies and clearances will be conducted at that time and mitigation measures will be developed and required.

C-117: The Bozeman Pass area has been identified by land management agencies (Montana Fish, Wildlife and Parks, U.S. Forest Service, Interagency Grizzly Bear Committee) as critical for wildlife linkage. The issue of habitat and population connectivity for wide-ranging species such as deer, elk, wolves, mountain lions, bears, lynx, wolverine and others must be addressed in the Statewide Oil and Gas Environmental Impact Statement.

R-117: See ***R-1***.

C-118: The Wildlife Mitigation and Monitoring Plans section states that if disagreements between company and agencies representatives cannot be resolved, the BLM should retain the right to order a certain action in the case of a stalemate.

R-118: Although the intent of the WMPP is to apply Conditions of Approval to the APD and project plan for wildlife impacts in cooperation with industry, it is understood that BLM has the authority to implement COA as deemed appropriate and justified. Administrative Appeal processes are available to concerned parties.

C-119: BLM admits that the existing sage grouse lease stipulations are inadequate to protect the sage grouse.

R-119: **See R-77**.

C-120: In Chapter 4, Aquatic Resources, the agencies state the "impacts on aquatic habitat and biota from the magnitude of [Wyoming] discharge also would be substantial." The agencies make no effort to quantify the impacts of CBM discharges from Wyoming on aquatic life much less discuss and quantify the cumulative impacts of such discharges when combined with discharges from Montana development.

R-120: As stated in the EIS, Montana and Wyoming DEQs have agreed to set discharge permit limits that result in no impact on Montana waters. Therefore, there would be no potential for combined cumulative impacts on Montana waters.

C-121: In Chapter 3, Wildlife, it states that a wide variety of neo-tropical migrants pass through or breed in the planning areas. Which species? Do they pass through or just breed?

R-121: Most pass through and a smaller number of species remain to breed, with the largest number of species found in riparian areas and wetlands.

C-122: Chapter 4, Alternative A, Conclusions, reads, "Cumulative impacts from CBM development in Wyoming would have an impact, particularly those species that spend all or part of their life in or near the Powder, Little Powder, or Tongue Rivers." Please identify the species.

R-122: See ***R-1***.

C-123: Regarding impacts on wildlife from Alternative C, even though this Alternative and Alternative E would have 30 percent more surface disturbance than Alternatives B and D because travel corridors would not be required, the EIS uses identical language to described the impacts "direct and indirect impacts on wildlife from this scale of development would be both widespread and substantial."

R-123: The scale of development for all of the alternatives is so large that all would have widespread impacts on wildlife, proportional to the level of disturbance and human activity.

C-124: In the EIS, the agencies state that "a more detailed monitoring program for wildlife will be included in the FEIS." Neither the public; FWS; Montana Department of Fish, Wildlife and Parks; nor other agencies will have an opportunity to comment on the wildlife monitoring program.

R-124: A more detailed WMPP has been developed for the FEIS and included in the Wildlife Appendix. This plan was developed with the assistance of the FWS; Montana Department of Fish, Wildlife and Parks; and BLM biologists.

C-125: The BLM has not prepared a biological assessment for any of the listed species in the planning area or for any of the candidate species and has therefore violated the ESA.

R-125: The BLM has completed formal consultation with the USFWS. This effort was ongoing at the time the DEIS was issued. Refer to the Biological Assessment and Biological Opinion located in the Wildlife Appendix.

C-126: Chapter 4, Alternative A, Conclusions, reads, "If habitat degradation is kept at a minimum … by this alternative." This sentence is 80 words long, not to mention confusing. What does "affected but are not likely to be critically affected, directly, by this alternative" mean"?

R-126: The text has been reviewed and modified.

C-127: Creation of impoundment may alter livestock and wildlife migration patterns, benefit some species over others resulting in changes to wildlife population dynamics, what happens when water is no longer available?

R-127: Any benefits to wildlife would cease at this time when impoundments are dry.

C-128: Chapter 3, Wildlife states that the planning area supports 10 species of bats, 8 species of shrews, 34 species of small mammals, 17 species of omnivores, and 5 to 7 big game species for total of 74 to 76 species of mammals. The EIS refers to 250 species of birds, 9 species of amphibians, 14 species of reptiles. Letters in the Wildlife Appendix state that there are 6 species of amphibians, 12 species of reptiles, 184 species of birds, and 43 species of mammals known to occur in the planning area.

R-128: We believe that the information in the EIS is correct as it was obtained from the Montana Gap Analysis Project and is based on habitat types present in the project area.

C-129: A wealth of wildlife data is available from EISs completed over the years for projects in the Billings and Powder River Resource Areas of Montana, including a proposed railroad, countless proposed and operating coal mines and power plants, etc. Where is this data?

R-129: Information from these sources was incorporated into this document, especially in Chapter 3. This information will also be useful during site-specific planning efforts.

C-130: In Chapter 3, Wildlife, please explain how timing and controlled surface use stipulations will protect wildlife populations and their habitat.

R-130: Timing and controlled surface use stipulations are intended to avoid some impacts on wildlife during sensitive periods. However, as pointed out in the EIS, these generally apply to exploration activities only. Therefore, these stipulations will not avoid any impacts during the CBM development and production phases. However, timing and controlled surface use stipulations may be applied site and project specific, as Conditions of Approval to the APD. Timing, controlled use and other measures are suggested practices in the WMPP.

C-131: In Chapter 4, Wildlife, under Assumptions, the BLM admits that existing sage grouse stipulations are inadequate but does not revise them. Why?

R-131: Leasing decisions are outside the scope of the plan. However, as stated in R-46 and R-48 additional protective measures provided in the WMPP may be implemented. **See R-77**.

C-132: In Chapter 4, Wildlife, under Assumptions, the BLM needs to develop stipulations for mountain plover, burrowing owl, and other species of concern, as well as other mitigation measures.

R-132: Inventory requirements and recommendations are included in the WMPP in the Wildlife Appendix may be implemented on a case-by-case basis. The mountain plover is addressed in the Terms and Conditions of the Biological Opinion.

C-133: In Chapter 4, Wildlife, Alternative A, it states that a detailed discussion of the impacts and mitigation measures for wildlife is included in the remainder of this section and the Wildlife Appendix. Where is the detailed discussion of the wildlife impacts and mitigation measures in the Wildlife Appendix?

R-133: The reference was incorrect and has been removed from the text.

C-134: Chapter 4, Wildlife, Alternative A Species of Concern, includes 9 federally list species (pallid sturgeon, bald eagle, mountain plover, interior least turn, gray wolf, Canada lynx, black-footed ferret, grizzly bear) and 3 federal candidate species (black-tailed prairie dog). What are the other two candidate species under the ESA?

R-134: The remaining two candidate species are the Montana arctic grayling and warm spring zaitzevian riffle beetle.

C-135: Chapter 4, Wildlife, Alternative A, states transmission lines may kill bald eagles because of electrocution. Impacts would be different if powerlines were required to be buried versus allowing them to be overhead.

R-135: The text has been modified to reflect the fact that the risk of electrocution on federal and state lands is small because the BLM and state will require that all powerlines and poles be constructed to standards that will avoid raptor electrocution (see the Minerals Appendix for details). Burying powerlines will be required in certain circumstances for specific species. See Biological Opinion and WMPP.

C-136: In Chapter 4, Wildlife, Alternative A, Mitigation, would mitigation measures apply to federal, state, and private lands?

R-136: The Minerals Appendix indicates which mitigation measures would apply to federal or state lands. Some Wildlife Mitigation measures may not be required on private lands by MBOGC policy.

C-137: In Chapter 4, Wildlife, Alternative A, Mitigation, what about surveys for proposed pipeline rights of way, transmission line corridors, compressor stations, impoundment and other water collection and disposal facilities? Will construction be allowed to proceed during the May 1 to June 15 period? How will this mitigate impacts on populations in subsequent years when these areas have been disturbed?

R-137: The BLM is fully committed to conducting site-specific surveys and clearances and to determining impacts from specific CBM projects when Project Plans are reviewed. Appropriate mitigation measures will be developed and required. Construction activities can be precluded as part of the Conditions of Approval under standard stipulations that allow up to a 60-day delay of activities. Additional stipulations can be applied as needed as part of the WMPP, but are not specified at this time.

C-138: Chapter 4, Wildlife, Alternative A, Mitigation, states no mitigation measures proposed for black-footed ferret-listed species.

R-138: Any black-footed ferrets located in project areas would have to be avoided in accordance with the provisions of the ESA. See Biological Opinion, Wildlife Appendix.

C-139: Chapter 4, Wildlife, Impacts From Management Specific to each Alternative: failure to quantify the cumulative impacts of Montana and Wyoming development on any species.

R-139: The EIS states, "Impacts from Wyoming CBM development on wildlife and wildlife habitat would be similar to those described under Alternative A, but at a far larger scale. More than 7.5 times as many CBM wells may be developed in the Powder River Basin of Wyoming than the 18,300 considered under Alternatives B, C, and D. The magnitude of direct and indirect Wyoming CBM impacts on wildlife and wildlife habitat would be about 7.5 times greater than described for Alternatives B, C, and D (described in the following sections). Large areas of riparian habitat would likely be impacted by erosion because of substantially higher flows and by higher SAR levels that are harmful to many plants. Groundwater drawdown would likely dry up many springs and reduce flows or dry up intermittent streams throughout the Powder River Basin of Wyoming and well into Montana. This would result in the direct loss of habitat and degrade habitat values on lands around springs and intermittent streams because natural water sources would be eliminated."

C-140: Chapter 4, Wildlife, Alternative B: "Sage grouse could be especially hard hit". What does "especially hard hit" mean?

R-140: It means that among wildlife species impacted by CBM development, sage grouse would be among those most affected. The text has been clarified. Also see R-46 and R-48. Sage grouse will be a very high focus during CBM development because of its present status. See WMPP, Wildlife Appendix.

C-141: In Chapter 4, Wildlife, there are no cumulative impacts from Alternative C because there is no Conclusion section for this alternative.

R-141: A conclusion section has been added to the EIS.

C-142: In Chapter 4, Wildlife, Alternative E, quantify what "potentially less severe" means.

R-142: See ***R-1*** regarding quantification of impacts.

C-143: In Chapter 4, Wildlife, Alternative E, explain how monitoring will mitigate or avoid impacts on wildlife species and habitat. Define "objectives for wildlife."

R-143: See the WMPP in the in the Wildlife Appendix for further discussion of how monitoring and adaptive management will be applied to CBM development.

C-144: In Chapter 4, Wildlife, Alternative E, what is meant by "adaptive environmental management principles."

R-144: See ***R-144***. Also, adaptive management is a process of monitoring effects at various landscape scales and modifying future management decisions to reduce or avoid identified impacts.

C-145: In Chapter 4, Wildlife, Alternative E, amphibians and reptiles are not discussed.

R-145: The discussion of impacts of Alternative E refers back to earlier discussions. Therefore, there is no discussion of any specific wildlife groups.

C-146: Chapter 3, Special Status Species states that sicklefin chub and sturgeon chub were petitioned for listing under the ESA, but they were not listed. Where is the analysis of the impacts on the sicklefin chub and sturgeon chub?

R-146: The nature of the EIS does not support detailed analysis of effects to specific species because there are no specific project locations identified at this time. Discussions of specific species under the heading of Special Status Species are limited to federally listed or candidate species. The general effects discussions in the Aquatics section apply to sturgeon chub. The data base will be reviewed for the occurrence of sicklefin chub in project area drainages for assessment in the EIS.

C-147: Chapter 4, Aquatic Resources, Alternative E concludes that "Impacts on aquatic resources associated with Alternative E would generally be comparable to the CBM related impacts described for Alternative B, which emphasizes the protection of natural and cultural resources." What is the basis for this conclusion?

R-147: Chapter 2 compares the different features of all the alternatives. That table notes the many ways in which Alternative E is similar to Alternative B, and where it is not, BMPs and mitigation measures would be implemented to avoid or minimize the potential for impacting aquatic resources. The EIS analysis of Alternative E notes the potential for increased sediment delivery as compared to Alternative B because of differences in transportation corridors. Both Alternative B and E are aimed at implementing measures that would avoid water quality degradation and impacts on aquatic resources.

C-148: Reclamation and bonding agreements should clearly guarantee that CBM producers have adequate funds to insure that game species are reclaimed to pre-development populations.

R-148: The BLM's policy requires reclamation of disturbed lands, not restoration of habitats present before disturbance. There is no requirement to specifically re-establish native grasses, forbs, or shrubs, although these species may be included in seed mixes. The EIS states, "The intent of reclamation is to re-establish a vegetative cover on disturbed areas rather than to restore native plant communities, as they existed prior to disturbance. Plant species diversity would be lower on reclaimed sites that before disturbance, reducing overall wildlife habitat values for the foreseeable future. Mitigation measures would not be effective at compensating for the indirect impacts on wildlife." There is no assurance or condition in the bonding agreements concerning wildlife habitat value of reclaimed areas.

C-149: Why are seven of the nine wildlife issues listed on page 1-15 (DEIS)not addressed?

R-149: All of these topics have been addressed in the EIS.

C-150: What is the effect of the CBM water on biota of the streams where it is dumped?

R-150: Potential effects on biota of discharging CBM water to streams are discussed in Chapter 4 in the Aquatic Resources Section of the DEIS. The analysis discusses the potential effects on aquatic habitat and resources from changes in flows, salinity, and TDS of the receiving stream. Several examples are presented that calculate resultant TDS concentrations and expected effects on aquatic life from discharging a given volume of CBM water with specific characteristics to a receiving drainage with a specific flow and specific characteristics. The potential effects vary among alternatives based on operational criteria and according to the nature of BMPs and mitigation measures that would be implemented. For example, some alternatives would treat production water before it is discharged while others would discharge untreated water over the ground surface.

C-151: The DEIS admits that CBM water discharges will render surface waters unsuitable for irrigation (SAR greater than 12) in many drainages, yet the draft EIS fails to disclose that these discharges will exceed numeric standards being proposed by the state and tribe. While the draft EIS acknowledges the direct effects of high SAR water on riparian vegetation and agricultural crops, the document fails to analyze the magnitude, duration, scope or indirect effects of the impact. What will be the consequences to the wildlife and fisheries of the region when riparian areas are negatively impacted.

R-151: Given the nature of this EIS, it is not possible to estimate the magnitude of the impacts on riparian vegetation. However, any impacts of high SAR water would be negative. Riparian communities in shortgrass prairie ecosystems provide essential habitat for a wide range of species and any losses would impact numerous species, including several that are already declining throughout all or a portion of their range. The importance of riparian communities to a healthy aquatic ecosystem is also discussed in the Aquatic Resources Section of Chapter 4. Potential effects on instream habitat and aquatic resources from degraded riparian conditions and function, regardless of the cause, can include: reduced overhead cover; reduced bank stability and cover; reduced recruitment of woody or brushy debris to the stream, which provides fish cover and habitat diversity; reduced external food sources (e.g. insects falling to the water's surface); and warmer water temperatures during summer and colder water temperatures during winter.

C-152: Alternative D under Hydrological Resources states that treated discharge water may affect the temperature of the surface water body receiving the discharge. The effects of this anticipated temperature change are not mentioned in the Aquatic Resources section.

R-152: The potential effects of the possible temperature change resulting from the discharge of CBM water under Alternatives A, C, D, and E have been addressed in the Aquatic Resources section of this Final EIS. There would be no discharge of CBM water under Alternative B.

C-153: It is conceivable that the cumulative effects of cold discharges from CBM wells will affect warm water aquatic systems such as the Tongue River and Powder Rivers. These rivers are home to populations of dwindling native fish species such as sauger, blue sucker and, in their lower reaches, pallid sturgeon.

R-153: The potential effects of the possible temperature change resulting from the discharge of CBM water under Alternatives A, C, D, and E have been addressed in the Aquatic Resources section of this Final EIS.

C-154: How can the effectiveness of these mitigation measures be the same for Alternative A (almost no development—250 producing wells) and Alternative C (18,300 producing wells) without travel corridors or other protections—emphasizing CBM development?

R-154: The effectiveness of a mitigation measure does not depend on the number of wells, but rather on the action being taken. In addition, as noted in the Conclusions section for Alternative C, the types of residual impacts (those impacts remaining after mitigation) that would persist for Alternative C are the same as described for Alternative A, but they would occur on a far greater scale. This is because of the far greater number of CBM wells under Alternative C than Alternative A. The residual impacts of substantially greater discharges to surface waters of CBM-production water also are noted for Alternative C.

C-155: It is expected that impacts on sage grouse in one state will also affect sage grouse in the adjacent state.

R-155: Sage grouse are known to move as much as 100 miles between nesting, rearing, and wintering areas and wintering areas can vary from year to year depending on the severity of the winter. Therefore, you may be correct that impacts on sage grouse or sage grouse habitat in one state could affect sage grouse in another nearby state.

C-156: The DEIS calls for placing "walk-in signs" as a mitigation measure, but the success of such signage is unproven and suspect.

R-156: Although the FEIS includes walk-in signs as a potential mitigation measure implemented by the state, no impacts were reduced as a result of incorporating this concept.

C-157: If prairie dogs are to be restored to viable numbers to avoid listing under the ESA, suitable non-occupied habitat must be available. CBM could preclude such restoration.

R-157: You are correct that CBM development may preclude reoccupation of some suitable habitat by prairie dogs.

C-158: BLM and the State of Montana have signed an agreement to manage sage grouse. This EIS fails to consider an alternative which is responsive to this decline, or which may achieve the obligations of the MOU and the related guidelines.

R-158: The BLM has signed a national MOU with the western state agencies and other federal agencies to agree to work cooperatively for sagebrush and sage grouse conservation.

Distribution List

The BLM requested comments from industries, businesses, individuals, and special interest groups, federal, state, and local agencies and from Native American tribes. Information has been distributed to the organizations, agencies, and individuals listed.

A

Eugene S Aby
Adventures Women Inc
Peter Aengst
Tom Agnew
Roy Alexander
ALL Consulting
Virginia L Allen
William Almy
AM Energy
American Fisheries Society
American Lands
American Wildlands
Jerry Anderberg
Patricia and Ivan Anderson
Donald W. Anderson
Clyde and Sally Angove
Aqua Terra Consultant
Walter Archer
J H Armstrong
Carl Arnatt
James and Alice Arthur
Tom Asay
Clyde Aspevig
Adelaide Astrom
Janice Astrom
Aqua Terra Consultants
Marlyn Atkins
Montie Auer
Aviara Energy Corp
Earl and Betty Aye

B

Darell and Sue Bache
Daniel Bakker
Kenneth K Baldwin
Keith Bales
Dave Ballard
W W Ballard
Ballard Petroleum Holdings LLC
Charles Ballek
Ronis M Ballinger
Banko Petroleum Management
Anne Banks
Tom Bansak
Jim Barngrover
Jeanette Barnes
Barrel Mountaineering
Jim Barrett
Randy and Stephanie Barth
Basin Electric Power Company
Rick Bass
Senator Max Baucus
Tony Baumgartner
Mike and Lisa Bay
Shirley and Robert Bayley
Urban Bear Don't Walk
Beartooth Oil & Gas
Bob Beck
Tony Becker
Sharon Bedford
Benge Ranch Inc
Dan Bennett
Dennis Berklund
Charles Bertsch
Shawn Bettise
Bice Ranch
Steve Bickwermert
Big Horn Conservation District
Big Horn County Commissioners
Big Horn County Planning Board
Big Sky Coal Company
Bill Barrett Corporation
Billings Chamber Of Commerce
Billings Gazette
Billings Gazette - City Desk
Nettemae Binnie
Bison Engineering
Bittercreek Pipeline LLC
Norma Bixby
Brian Bjella
Bjork Lindley Danielson & Baker
BKS Environmental
Black Hills Exploration & Prod Inc
Joanne Blake
Kathleen K. Blehm
BLM Cody Field Office
BLM Buffalo Field Office
BLM Great Falls Field Office
BLM Miles City Field Office
BLM Montana State Office
BLM Oregon State Office
Mike Blum
Bruce H Blumenshine
Mary Bluemle
Howard Boggess
Bones Brothers Ranch
Maryon Border
Christopher Borton
Barbara and Kent Bourbon
Dru Bower

Bowers Oil & Gas Explor Inc
Laura Bowker
R J Boyle
Joseph Brady
Otto Braided Hair
Kerby Brandon
Kim Brandon
Mark Bremer
Brian Creek Cattle Co
Lance and Cheryl Brill
Broadus Chamber of Commerce
Gary Broeder
Michael Brown
Tom Brown Inc
Aaron Browning
Don Brutlag
Buck Mountain Ranch
Bureau of Indian Affairs – Crow Agency
Bureau of Indian Affairs – Northern Cheyenne Agency
Bureau of Indian Affairs – Area Office
Bureau of Reclamation
Henry Burgess
Scott Burley
Burlington Resources Oil & Gas Co
Shauna Burns
Senator Conrad Burns
Jim Butler
Chuck Buus
Buys Association Inc
William Byxbe

C

William and Maggie Caffyn
Bill Cagle
Steve Caldwell
Bill Campbell
Craig Campbell
John Campbell
Campen Consultants
Camwest Limited Partnership
Anita Canovas
CARDD
Carbon County Commissioners
Caribou Land & Livestock
Isabelle Carlhan
Wayne j Carlisle
Sarah Carlson
S Carpenter
Bob Carroll
Charles Carson
Waylon and Madeline Carson
Donna Carusohirst
Mike Caskey
Casper Tribune
Nona Chambers
Bill Champion
Brian and Lynn Chan
Michael and Hia Chapin
Jim Chase
Kevin Chartier
Steve Chestnut
John Childs
Ramona Clark
William Clarke
Laurie Claypool
Clementine Ranch
Cline Production Co
Richard C Clotfelter
CMS Energy
CNX Land Resources Inc
Connie Cole
Senator Mack Cole
Coleman Oil Gas Inc
Jim Collins
Colstrip Area Assoc of Business
Dwight Conley
Sally and Gary Conner
Stuart Conner
Henry Connor
Jannis Conselyea
Consol Energy Inc
Continental Resources Inc
Anne Cossitt
John Coston
Cottonwood Resource
Randall T Cox
T H Crawford
Deb and Tim Crennen
Luigia Crippa
Senator William Crismore
Jim Cross
Louise Cross
Crowley Law Firm
Crow Tribal Chairman
Crow Tribal Contracts Office
Crow Tribal Council
Crow Tribal Council Chair
Crow Tribal EPA
Crow Tribe
Mark Cunnane
Bill Cunningham
James F Curtis
Custer National Forest

D

Curt Dahlgaard
Jan Dahlgaard
William Dakin
Judy Daniels

Robert Danskin
Karen Davidson
David L Davis
Jerry and Margaret Davis
Dean & Associates Cons
Decker Coal Co
Defenders of Wildlife
J M DeGange
Karen Demaine
Donald Denowh
Debra DeBode
Department of Environmental Science
Department Of Natural Resources & Conservation
Hawley Desimon
Gennie Deweese
Mark Dick
James R. Dickey
Dee Diedrich
Robin Diedrich
Phil Dinsmore
Curtis L Ditzell
Richard & Cleda Dix
Krista Dixon
Bill Dodd
DOI Solicitor's Office
Ben Donegan
Alvin West Donohoe
Dave and Joanne Dorwart
Robert Downey
Lois J Drobish
Pat and John Drumheller
DTM Consulting Inc
Andrew Duke
Sandra Dunham
Jack Dunn

E

88 Oil Company
Ben Earley
Tom Ebzery
EDM Inc
Francis Edwards
Paul Edwards
Stephen Egli
Leonard & Dorothy Ehlang
Elenburg Exploration Inc
Terry Elliot
Elk Point Resources
Elk River Law Office Pllp
Ellsworth Geological
James Emerson
Tom and Ann Emmons
Encore Operating LP
Mike England
Mark Engle
ENSR
Environmental Information Center
Environmental Quality Council
Environmental Protection Agency Montana Off
Environmental Protection Agency Region 8
Equity Oil Co
LeRoy R Erickson
Kirth Erickson
ESN Rocky Mountain
Tom Etchart
Bob Evans
Exodus Inc

F

Judith Fahrnow
Pam Farmer
Pat Farmer
F Shelton Farr
Joseph C Femling
Ron Fenex
FERC
Tom Ferguson
D Fincham
Fidelity E&P
Doris Fischer
Joanne Fisher
Francie and Robert Fisher
Flathead Wildlife Inc
L Dwayne Flinn
Gloria Flora
Mayre Flowers
Tankard Floyd
Flying J Oil & Gas Inc
Ted Flynn
FL Ranch
Dan K and Jeanne Folson
Kate Forsting
Kenneth E Fortney
Fort Peck Tribal Minerals
Mary Jo Fox
Brenda Fradenburgh
John Fredlund
Charlie French
Vail P Freyer
Mert and Vicki Freyholtz
Clark Fritz
Paul D Fritz
Amy Frykman
Fulton Fuel Co
Les Fuglevand
Elizabeth M Fulton
William M Fulton

G

Galliton County Planning Dept
George Galuska
Ken Gard
Donald A. Garrity
Glenn Gay
Thomas F Geary
GEI Consulting Inc
Georesources Inc
Kathleen George
Charlie Gephart
Polly A Gill
Richard W Gillette
Eugene and Heidi Giordano
Mark Goetz
Golder Ranch
Steven Glow
Martin Glynn
Darrell Goebel
Robb Goodell
Greg Gordon
Gordon Cattle Company
Dave Gorton
Alfred Graesser
John W Graham Jr
Grand Resources Ltd
R J Graveline
Greater Yellowstone Coalition
William Greiner
Greystone
Paul Grigsby
Grouse Inc
Sid & Evelyn Grovenstein
Ben J Gruner
Prudence L Grunkemeyer
James W. Guercio
Byron Guertzgen

H

Steve Haag
Janet Haarvig
Kim Hackl
Marian Hadzor
John Hafla
Marvin Hafla
Alrick Hale
Bernard D Hall
Bradley Hall
Brenda Lindlief Hall
Hallmark Adventures Inc
Richard Halstadt
Linda Halsteadacharya
Martin Hamilton
Robin L Hamilton
Earnest Hammer
Beverly K Hancock
Hancock Enterprises
Norma Hanks
Joseph W Hanna
James N Hannah
Carol A Hansen
Marian Hanson
Becky Hardey
Hardin Chamber Of Commerce
Diane Hargreaves
Scott Harmon
Donald Harr
Harrington Bibler
Gray Harris
John Hart
Bonnie Hash
Kevin Harvey
Steven Hawley
Headington Oil Company
Laura & Jim Heck
Joseph J Hegel
Oscar L Heinrich
George Heliker
Dave Helvey
Patricia Helvey
Pat Hennessey
Henry Malley Memorial Library
Cy Hentges
Lawrence and Mary Lou Heppner
Bucky Heringer
Barry C. Hessenius
Hidden Valley Ranch
Kathryn Hiestand
Susan Hills
Steve Hlebichuk
Bert Hoatman
John Hodnik
Margaret Hofacker
Alvin and Dena Hoff
Paul Hoff
Richard L Hogan
Earl Hogge
Thomas K. Hohn
Holland Hart
Laura and Brett Holmquist
Holmes Ranch
Gary Holsan
Homestake Oil and Gas Company
Jodi Hubbard
William R Hubber
Shirley Hudson
Nicholas M Hughes
Alice and Jay Frank Huller
Raso Hultgren

Gary Huntscovy
Greg and Rachel Huntscovy
Jeff Hunt
Ted Huss
William Hutchison
Bonnie Hyattmurphy
Hydrometrics Inc

I

Independent Petroleum Association
Industrial & Energy Min Bureau
Jerry Inman
Inman Real Estate
Integrated Weed Service
IPAMS
C B Irgens
Nellie Israel
Neil and Rosemary Isto
Jerry Iverson

J

JA Rohn Consulting
Ralph A Jackson
Reuel G Janson
Blaine Janz
Phil Jaquith
Clyde Jarvis
Gerry and Chuck Jennings
Robert E Jewell
Bruce Jodar
Ann Johnson
Debra Johnson
Jewellene Johnson
Penny Johnson
Robert Johnson
Tamara J Johnson
Johnson, Grassel & Gorham Llc
Robert Johnston
Curt Jones
James W Jones
Patrick D Jones
Sonja C Jones
Steven Jones
JM Huber Corporation
Robert A Jordan
Gayle Joslin
Patrick Judge
Jeff Juel

K

Beth Kaeding
Ken Kamon
Herb Kane
Brad Kant
C G Katselas
Van P Keele
Keesun Corp
Joe Kehl
Cynthia Keller
Kennecott Energy
June Kennick
Robert Kensinger
Paul and Vicki Kent
Richard Kent
Keith Kerbel
John Robert Kerns
Key Production Company
Mollie Kieran
Tami Kimball
Sandy Kindt
Cynthia Kingston
Klabzuba Oil & Gas Inc
Bruce Kline
Karson Kluver
Joseph W Knotek
Lars Knudson
Bob Kober
Lee Racheal Kosnik
Tony Kowis
Carmen Kraft
Marilyn Krause
Delores Krieger
KTVM TV
Janelle Kuechle
Frank Kuehn
Joe Kurkowski
Brian Kurth
Caroline Kutz

L

Eric W Labouvie
Maryvette Labrie
J LaClair
Ken & Marcia Lane
John Langstaff
Barbara and Stirling Lantz
LAO Environmental
Mark Larsen
Vince Larsen
Anders and Laura Larson
Julie Larson
Jack and Pat Larmoyeux
Dave Larsen
Vince Larsen
Dale Lawrence
Thomas K Lawson
Don R. Lee

John R. Lee
Frederick Lefthand
Philip N Lehner
Ralph Lenhart
Peter Lesica
Evangeline LeVeque
Stuart Lewin
Ellen Lewis
Stephen and Meredith Lewis
Little Big Horn College
Dean Littlepage
Livingston Enterprise
Alan Lloyd
James F Logar
Conrad Anker and Jennifer Lowe
Carey Lowell
Marian Cotton Lower
Lower Brule Tribe
Darrell A. Lowrance
Paul Luehrmann
Stanley Lund
Eric Lunde
Cathy Lungren
Tom Luoma
Luther Appraisal Services
Willard & Shirley Lybeck
Daniel and Marilyn Lynn
Nancy Lynne

M

M & K Oil Co Inc
Mike Machler
Beth MacConnell
Barbara Macioroski
Colleen Mackcanty
Macum Energy Inc
Magic City Fly Fisher
Earl Mainwaring
Max A Makich
Joyce & Monte Malley
Johnathon Malo
Betty Lou Mann
Lillian Manry
Marathon Oil Company
Cynthia Marble
Bob Marosok
Robert Marshall
Katie Marske
P C Martens
Brian Matz
Kay K McAllister
Mari McCann
K W McCaskill
Michael McClary
Jimmy McClure
Roy and Susan McClure
Dave McCoskery
Clayton McCracken
Angela Mc Dannel
Allen Mc Droo
Laurence and Carol McEvoy
Richard M McKay
Tom McKerlick
Margarita Mclarty
William C McLaughlin
Janet McMillan
Warren A. McMillan
Doug McRae
Wally McRae
McRae & Henry Ltd
Laura V Meller
Walter Merschat
Matthew Meyer
Christine Michaels
Tim Michelsen
Miles City Chamber Of Commerce
Miles City Star
Bonnie Miller
Keith Miller
Susan L Miller
Miller Cattle Company
Minot State University
Bobbie J Mitchell
Patrick Miranda
Miratech Corporation
J. R. Mitchell
Irene Moffett
Marlin Mogan
Craig Mohr
John V Molenar
Hope M Mommer
Joan Montagne
Montalban O&G Op Cbm Bldg
Montana Coal Council
Montana Dakota Utilities
Montana Department of Environmental Quality
Montana Department of Natural
Resources & Conservation
Montana Department of Transportation
Montana Farm Bureau District 5
Montana Farmers Union
Montana Petroleum Association
Montana River Association
Jim Moore
John Morrison
Mountain Pacific General Inc
MSE Technology Application
MSU Billings
Mt Assoc of Counties
Mt Assoc of Petroleum
Mt Bureau of Mines & Geology

Mt Chamber of Commerce
MT Council of Trout Un
Mt DNRC Water Resources Div
Mt Environmental Quality Council
Mt Farm Bureau Federation
Mt Fish Wildlife & Parks
Mt Petroleum Association
Mt Public Lands Council
Mt State Historical Preservation Office
Mt State Parks Assoc
Mt Wildlife Federation
Molly L Munro
Robert G. Munson
David Murnion
Don and Gayle Murray
Jeff Mussleman
Amy Myran

N

Nance Petroleum Corp
Stewart Nash
Sherri Nassar
National Park Service
National Wildlife Federation
National Wildlife Society
Native Action
Gerald Navratil
Karin Neff
Carl Z Newtar
Nicklin Earth Water
W J Nicholls
Dan Nichols
Robert Nimmick
E T Nobles
Thomas C Noreen
Nancy Norsby
North American Grouse PA
North Western Energy
Northern Cheyenne Chamber of Commerce
Northern Cheyenne Cultural Committee
Northern Cheyenne Tribal Chair
Northern Cheyenne Tribal Consultant
Northern Cheyenne Tribe
Northern Montana Oil & Gas
Northern Oil Production Inc
Northern Plains Resource Council
Northern Pump & Compression
Northern Rockie Regional Off
Northern Wyoming Systems
Northstar Gas Co
Richard J Norton
Earl Norwood
Nancy N Norvell
Jack P Novosel
NRCE
NRCS
Kathy T Nygaardlange

O

O&G Environmental Consulting LLC
Roy Oconnor
Ocean Energy Resources Inc
David Odt
Office of Surface Mining
Sam Ohlson
Oilgener
Neta Old Elk
Keith High and Jennifer Oloughlin
Alan Olsen
Daniel L and Eric Olsen
Heather S Olson
Jeanne E Oneill
Rita Oneill
Steve Orr
Harold Ort
Ken Osborne
Leo R Ost
Richard Osterman
Loren J. O'toole
Dan and Shauna Ottman
Joe Owen
Peggy M Owens

P

Padlock Ranch
Julia Page
Mary E Pannell
Jean Parker
John A Parodi
L Arlie Paschke
Spencer Parsons
Steve Paulson
Peabody Development Company
Peabody Group
Peabody Natural Gas LLC
Moriah Peck
David L Pengelly
Pennaco Energy Inc
David Percival
Permitco Inc
Permits West
Charlene Perry
Robert S Pfeiffer
Ellen Pfister
Jim Phelps
George Pilgrim
Gil Jordan and Kim Pinter
Margaret Pittendrigh
Jeffery Phillips

E G Pittman
Frankie and Linda Planichek
Peg Platt
Susan Plath
James Poell
John Poire
Robert W Pond
Portage Environmental Inc
Cherry Porten
A. Hayden Porter
F. Porter
Pamela Poulsen
Powder River County Commissioners
Powder River Gas LLC
Powder River Conservation Dist
Powers Energy Corporation
Dorothy L and Dwight Preston
Preston Reynolds & Co Inc
Kris Prinzins
Public Lands Advocacy
Public Lands Access Assoc
Public Lands Foundation
Pumps Plus

Q

Quaneco LLC
Quicksilver Resources Inc

R

Chuck Raches
Kathleen A Ralph
Eric Ramsey
Paul Rana
Kathe Randle
Ranck Oil Co
David Ravenport
Ranger Review
J R and Pat Rasmussen
Wyndy Rausenberger
Jennifer Read
W G Redfield
Roland Redmond
Steve and Bob Regele
Jane Reger
Representative Dennis Rehberg
Allen Rein
Shirley and Joe Renders
Resource Advisory Council
Richard Reynolds
Rhea Joy Lewis Tribe
Jessica Rhoades
Calvin Rice
Eldon Rice
Nathan A and Janet Rice
RN Rice
Gail and John Richardson
William R Richter
Robert E and Tomi Rickels
Anna Marie Rider
Gregory L Ridu
Paula Riesch
Burr Riesen
Chris Riley
John Riley
Rimrock Oil Co
Ritter Laber & Associates
Raymond Rizor
RN Rice
Terry Roach
Brian Roat
Robert Hawkins Inc
Kathy Roberts
Richard and Janet Roberts
Ernie Robinson
Major Robinson
Phillip and Carrie Robinson
Rocker Six Cattle Co
Rocky Mountain Environmental
Rocky Mountain Exploration
Rocky Mountain Oil Journal
Rocky Mtn Oil & Gas Assoc
Jean Roll
Roy L Roney
Lucille and Peter Ronning
Alison and Alicia Rose
Rosebud Conservation District
Rosebud County Commissioners
Rosebud County Extension Office
Rosebud Power Plant
Rosebud Protective Assoc
Rosebud/Treas Wildlife Assoc
Gloria Rosencranz
Nigel M Ross
G M & Marge Rossetter
Shawn Rost
Steve Ruffatto
Roughrider Power
Rupestrian Cyberservices

S

Doug Saarel
Norman Sahm
David W Salo
Samedan Oil Corp
Samson Resources Company
Sands Oil Co
Ron Santi
Robert A Schalla
John Scheiffelbein

Lee Scherer
Ted Schmidt
Tom Schneider
Peter Schoonmaker
R K Schraiter
Frank Schrater
Stephen Schreck
Franklin E Schroeter
Catherine Schuck
Nate Schulfer
William Schwarzkoph
Timothy and Karen Scott
Doris Seaman
Susan Seibert
Robert Semrow
Frank Sennott
John T Senrud
Jim Shaffer
Shane Creek Ranch
Herbert Sharbono
Arlo and Darlene Share
Mike Shenk
Colleen Shumway
Sheridan Chamber Of Commerce
Sheridan County Commissioners
Sheridan County News
Sheridan County Planning
Roger and Susan Sherman
Kenneth and Ann Shesne
Sierra Club
Roxanne Simpson
Erica Skinger
Stanely and Cecella Slater
Gail Small
Geri Small
Smith-Foster
Annick Smith
Christine Smith
Duane Smith
E Neil Smith
Jean E Smith
John and Judith Smith
Joe S. Smith
Keith Smith
Mike Smith
Phil and Debbie Smith
Darren Snow
Don Snow
Soap Creek Assoc Inc
Jeanne Souvigney
Spectrum Energy Inc
Spring Creek Coal Company
Kathy Standard
Harold Stanton
St. Oil Company
Douglas Stange
Bob Stanhope
Steigers Corporation
Vickie Steiner
Judy Stephenson
Bob and Hope Stevens
David and Nike Stevens
Stillwater Protective Assoc
Judy Stolzenburg
Robin Stout
Ernie Strum
John & Fay Stuker
Stephen J Stutebach
Maritn Suda
Greg Sullivan
Paul Sunblad
Suncor Energy
Swanson Drilling Company LLC
Robert Swinehart
Marlene Swisher

T

T&Y Irrigation
Todd Tanner
Ron & Twila Jo Talcott
Tarter Family Trust
Margaret Taylor
Norman E and Mary Taylor
Watty & Lila Taylor
Tegra Energy Services
The Ecology Center In
The Institute for Environ An
The Prosp Invest & Trad Co Ltd
Michael Thomas
Wayne Thompson
Three Bar Ranch
Greg Thurow
Pam Tierney- Crisafulli
Tomahawk Oil Co
Robert Tomich
Wayne Tomicich
Tongue River Farm
Lee Torgrimson
Pat and Dick Tourangeau
Deon Trangmoe
Treasure County Commissioners
Treetop Ranch Ltd
Bill Trumble
John Tubbs
Pat Tucker
James A Tuma
Thomas P Tuminello
Larry Tveit Sr
Hubert Two Leggins
Anne Trygstad
Jack Tuholske

Marvin and Joanne Twiss
Scott Tyler

U

U S EPA Region 8 Library Serials
US Geological Survey
Gary Unruh
US Department of Interior Fish
US Fish & Wildlife Service
US Geological Survey
USDA Forest Service
USDA – NRCS
Matthew Utnik

V

Valley Nursery
Rick VanAken
Mary Vandenbosch
Steven Vanfossen
Den VanPolsen
Willy VanStrasten
Fred Vanhorn
Robert Varner
George Vaught Jr
Joel G Vignere
Virginia Vincent
Alfred and Deanna Visborg
Robin Vogler
Bette Vonhess
Hal Vosen

W

Bill Wagner
Pat Wagner
Sara A Wagner
Verna Wagner
Bob Waldron
Harry Wallace
Stephanie and Ken Wallace
Glenn Waller
Jim Walseth
Richard Waltner
Mike Wamboldt
David Warburton
Russell Warchola
Bernt Ward
Washington Department of Ecology
John Watts
Donna J Watson
Rebecca W. Watson
WBI Holdings Inc
Jeff Weber
Jack A Webster
H A Webster
Wesco Resources Inc
Westech Environmental Services
Westport Oil & Gas Co Inc
Jay Westre
Michael Wheat
Judith Wheeler
Gordon and Janet Whirry
Luella White
Neil Whitehead
Mrs Leslie Wickland
Wicklin Earth & Water
Chuck Wideman
Ed Wierzbicki
Phyllis Wilcox
Peter T Wilczynski
Robert Wilkes
Burt Williams
Dale & Janie Williams
Roger Williams
Williams Production RMT Company
Lianne Williamson
Williston Industrial Supply Corp
Willy's Petroleum
Richard Wilmont
John Wilson
Kemp J. Wilson
Randy Wold
Robert E Wood
Arlan Woods
Evan and Cindy Woolston
Mary Wyman

Y

Yellowstone County Commissioners
Yellowstone County Weed
Yellowstone Public Radio
Yellowstone Valley Audubon Society
Denzil R. Young
Hildie Young
Richard C Young
Ken and Jenny Younger

Z

Scotty and Claire Zion
Mike Zmudzinski
Tom Zook
Sarah Zuzulock
Leo Zwemke

List of Preparers

BLM Core Team

Mary Bloom: CBM Program Manager, Team Leader, Miles City Field Office, Miles City, Montana.

Andrew L. Bobst: Hydrologist, Hydrology Resources Technical Coordination, Miles City Field Office, Miles City, Montana.

Kathy Bockness: Technical Coordination, Planning and Environmental Specialist, Miles City Field Office, Miles City, Montana.

David Breisch: Oil and Gas, Mineral Resource Specialist, Technical Coordination, Miles City Field Office, Miles City, Montana.

Chuck Laakso: Petroleum Engineer, Technical Coordination, BLM Miles City Field Office, Miles City, Montana.

Carol Larson: Staff Assistant, Bureau Quality Assurance Assistant, Miles City Field Office, Miles City, Montana.

Krista Madsen: Staff Assistant, Miles City Field Office, Miles City, Montana.

Larry Rau: Wildlife Biologist, Wildlife, Threatened and Endangered Species, Miles City Field Office, Miles City, Montana.

BLM Support Team

James A. Albano: Mineral Resource Specialist, Montana State Office, Billings, Montana.

Scott F. Archer: Senior Air Resources Specialist, Air Quality and Climate, National Science and Technology Center, Denver, Colorado.

Dan Benoit: Solid Minerals Geologist, Coal, Geology, Miles City Field Office, Miles City, Montana.

Tom Carroll: Realty Specialist, Lands and Realty, Billings Field Office, Billings, Montana.

Ken Hanify: Natural Resource Specialist, Minerals, Billings Field Office, Billings, Montana.

Dex Hight: Hydrologist, Hazardous Materials, Hydrology, Miles City Field Office, Miles City, Montana.

Will Hubbell: Archeologist, Cultural Resources, Miles City Field Office, Miles City, Montana.

Edward Hughes: Regional Economist, Economics, Montana State Office, Billings, Montana.

Shelia McNee: Supervisory Natural Resource Specialist, Livestock, Grazing, and Vegetation, Miles City Field Office, Miles City, Montana.

Robert Mitchell: Soil Scientist, Soil, Air, Miles City Field Office, Miles City, Montana.

Larry Padden: Range Management Specialist, Livestock Grazing, Vegetation, Billings Field Office, Billings, Montana.

Jay Parks: Wildlife Biologist, Wildlife, Billings Field Office, Billings, Montana.

Joan Trent: Sociologist, Sociology, Environmental Justice, Montana State Office, Billings, Montana.

Pam Wall: Realty Specialist, Lands and Realty, Miles City Field Office, Miles City, Montana.

BLM Management Team

Dave McIlnay: Miles City Field Manager

Sandra Brooks: Billings Field Manager

Scott Haight: Miles City Acting Associate Field Manager

Fred O'Ferrall: Miles City Assistant Field Manager, Minerals

Dale Tribby: Miles City Supervisory Natural Resource Specialist

Fred Wambolt: Miles City Supervisory Natural Resource Specialist

David Jaynes: Billings Assistant Field Manager

BLM Coordination Support and Review

Montana State Office, Miles City Field Office, Billings Field Office and BLM Wyoming staffs:

Division of Lands and Renewable Resources

Division of Mineral Resources

Division of Administration

State Team

State Core Team

Art Compton: Administrator, Planning, Prevention and Assistance Division.

Greg P. Hallsten: State Co-Lead Agency Representative, CBM Project Manager, Montana Department of Environmental Quality, Helena, Montana.

Tom Richmond: Administrator, Montana Board of Oil and Gas Conservation, Billings, Montana.

State Support Team

Board of Oil & Gas Conservation

Jim Halvorson: State Petroleum Geologist, Montana Board of Oil and Gas Conservation, Billings, Montana.

George Hudak: UIC Director, Montana Board of Oil & Gas Conservation, Billings, Montana.

Bureau of Mines & Geology

John R. Wheaton: Hydrogeologist, Montana Bureau of Mines & Geology, Billings, Montana.

Department of Environmental Quality

Jeff Blend: Economist, Socioeconomics, Montana Department of Environmental Quality, Helena, Montana.

Dale Herbort: Cultural Resources, Montana Department of Environmental Quality, Helena, Montana.

Abe Horpestad: Water Quality Specialist, Montana Department of Environmental Quality, Helena, Montana.

Bonnie Lovelace: Water Permitting, Montana Department of Environmental Quality, Helena, Montana.

Angela McDannel: Controlled Groundwater, Coal, Montana Department of Environmental Quality, Helena, Montana.

Eric Merchant: Air Quality Specialist, Montana Department of Environmental Quality, Helena, Montana.

Tom Reid: Water Discharge Permitting, Montana Department of Environmental Quality, Helena, Montana.

Department of Fish Wildlife and Parks

Don Skaar: Fisheries, Montana Fish, Wildlife and Parks, Helena, Montana.

Department of Natural Resources and Conservation

Keith Kerbel: Water Resources Specialist, Hydrology.

Teresa Kinley: Geologist/Hydrologist, State Owned Lands and Minerals

Russel Levens: Hydrogeologist, Hydrology.

Monte Mason: Minerals Management Bureau Chief, State Owned Lands and Minerals.

Sharon Moore: Natural Resources Specialist, State Owned Lands and Minerals.

State Historic Preservation Office

Stan Wilmoth: Cultural Resources, State Historic Preservation Office, Helena, Montana.

Consultant Team

Dan Arthur, P.E.: Project Manager, Petroleum Engineer, Hydrologist, ALL Consulting, Tulsa, Oklahoma.

Roy Arthur: Database Specialist, ALL Consulting, Tulsa, Oklahoma.

Chuck Blair, CWB: Wildlife Biologist, CH2M HILL, Boise, Idaho.

Dave Bockelmann: Petroleum Geologist, Geology and Minerals, Cultural Resources, ALL Consulting, St. Louis, Missouri.

Brian Bohm: Geologist/Sociologist, Hazardous Waste, ALL Consulting, St. Louis, Missouri.

Tim Burkhardt: Socioeconomics/Planner, CH2M HILL, Portland, Oregon.

Greg Casey, P.E.: Petroleum Engineer, Environmental Science, Hydrology, ALL Consulting, Houston, Texas.

David Epperly, Ph.D., P.E.: Agricultural Engineer, Soils, Livestock Grazing, Climate, ALL Consulting, Tulsa, Oklahoma.

Judy Ferguson: Environmental Scientist, CH2M HILL, Boise, Idaho.

George Fink, P.E.: Air Quality Scientist, CH2M HILL, Boise, Idaho.

Lynn Foster, RFB: Senior Aquatics Scientist, CH2M HILL, Boise, Idaho.

Amy Hopper: Planner, Recreation and Wilderness Study Areas, CH2M HILL, Portland, Oregon.

Timothy Jones, PhD: Archeologist, Cultural Resources, ALL Consulting, Phoenix, Arizona.

Fred Koethke: Planner/Social, Visual Resource Management, CH2M HILL, Boise, Idaho.

Bruce G. Langhus, Ph.D., CPG: Geology and Minerals, Hydrogeology, Paleontology, ALL Consulting, Tulsa, Oklahoma.

Jonathan Matthews: Land Use and Realty, CH2M HILL, Boise, Idaho.

Dennis Mengel, Ph.D., CPSS: Assistant Project Manager, Fish and Wildlife Biologist, CH2M HILL, Boise, Idaho.

Jason Patton: GIS Specialist, ALL Consulting, Tulsa, Oklahoma.

Jon W. Seekins: Assistant Project Manager, Environmental Scientist, Indian Trust, Environmental Justice, ALL Consulting, Tulsa, Oklahoma.

David Winter: Biologist, ALL Consulting, St. Louis, Missouri.

Official Cooperators

Bureau of Indian Affairs

Crow Tribe

U.S. Environmental Protection Agency

U.S. Department of Energy

GLOSSARY
BIBLIOGRAPHY
INDEX

MONTANA

GLOSSARY

7Q10. A statistical measure for the lowest flow expected for a continuous 7-day period in 10 years.

ABANDON. To cease producing gas from a well when it becomes unprofitable. A wildcat (exploration) well may be abandoned after it has been proven nonproductive. Usually, some of the casing is removed and salvaged, and one or more cement plugs placed in the borehole to prevent migration of fluids between formations.

ABNORMAL PRESSURE. Pressure exerted by a formation and exceeding or falling below the normal pressure to be expected at a given depth. Normal pressure increases approximately 0.465 psi per foot of depth. Formations with abnormally high pressure must be controlled to prevent a blowout.

ACID NEUTRALIZING CAPACITY. The extent to which natural water bodies are able to buffer atmospheric deposition of sulfate and/or nitrate particulate matter from air pollution emission sources.

ACRE-FOOT. A term used in measuring the volume of fluid. An acre-foot is the amount of fluid required to cover 1 acre to a depth of 1 foot, or 43,560 cubic feet (325,829 gallons).

AIR QUALITY. Air quality is based on the amount of pollutants emitted into the atmosphere and the dispersion potential of an area to dilute those pollutants.

ALKALINITY. The quantity and kinds of compounds present in water that collectively shift the pH to the alkaline side of neutrality. See **salinity**.

ALLOTMENT CATEGORIZATION. The grouping of livestock grazing allotments into the categories "M" (maintain current satisfactory condition), "I" (improve current unsatisfactory condition), and "C" (manage custodially while protecting existing resource values).

ALLUVIUM. General term for debris deposited by streams on river beds, floodplains, and alluvial fans, especially deposits brought down during a flood. Applies to stream deposits of recent time. Does not include below water sediments of seas and lakes.

ANIMAL UNIT. A standardized unit of measurement for range livestock or wildlife. Generally, one mature cow, one horse, five sheep, 9.6 antelope, 5.8 deer, or 1.9 elk, based on an average forage consumption of 26 pounds of dry matter per day.

ANIMAL UNIT MONTH. A standardized unit of measurement of the amount of forage necessary for the complete sustenance of one animal for one month; also, the measurement of the privilege of grazing one animal for one month.

ANNULUS OR ANNULAR SPACE. The space around a pipe in a wellbore, the outer wall of which may be the wall of either the borehole or the casing.

ANTICLINE. An arched, inverted-trough configuration of folded and stratified rock layers.

AQUIFER. A body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

APPLICATION FOR PERMIT TO DRILL, DEEPEN OR PLUG BACK (APD). The Department of Interior application permit form to authorize oil and gas drilling activities on federal land.

AREA OF CRITICAL ENVIRONMENTAL CONCERN. An area that needs special management attention to preserve historic, cultural, or scenic values; to protect fish and wildlife resources or other natural systems or processes; or to protect life and provide safety from natural hazards.

ARTESIAN. Groundwater with sufficient pressure to flow without pumping.

BANKHEAD-JONES FARM TENANT ACT OF 1937. This Act enabled the government to buy marginal farms and to put the farms back into grazing.

BASIN. A closed geologic structure in which the beds dip toward the center; the youngest rocks are at the center of a basin and are partly or completely ringed by progressively older rocks.

BEDROCK. The solid, unweathered rock underlying soils.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT). The best available air pollution control technology for a given emission source, considering environmental benefits, economic and energy costs, as defined by the applicable air quality regulatory authority.

BITUMINOUS. The most abundant rank of coal (synonymous with soft coal). It is dark brown to black and burns with a smoky flame.

BLOCK MANAGEMENT. Through cooperation with the Montana Fish, Wildlife, and Parks, a Memorandum of Understanding allows the BLM, the private landowners, and Montana Fish, Wildlife, and Parks to close off some public lands administered by BLM in exchange for opening up private lands to hunting. This is done on a rotating basis from year to year.

BLOOEY PIT. The pit that receives cuttings and other discharges from a well drilled with air.

BLOWOUT. An uncontrolled expulsion of gas, oil, or other fluids from a drilling well. A blowout, or "gusher," occurs when formation pressure exceeds the pressure applied to it by the column of drilling fluid and when blowout prevention equipment is absent or fails.

BLOWOUT PREVENTER. Equipment installed at the well head to prevent the escape of pressure either from the annular space between the casing and drill pipe or from an open hole during drilling and completion operations.

BRACKISH WATER. Water that contains relatively moderate concentrations of any soluble salts. Brackish water is saltier than fresh water but not as salty as salt water or brine water.

BRINE. Water containing relatively large concentrations of dissolved salts, particularly sodium chloride. Brine has higher salt concentrations than ordinary ocean water.

BRINE PIT. An excavated pit used to hold brine produced from a well.

BROWSE. As a verb, to consume or to feed on (as a plant); as a noun, the tender shoots, twigs, and leaves of trees and shrubs, often used as food by cattle, antelope, deer, elk, and other animals.

BUFFER ZONE.

1. An area between two different land uses that is intended to resist, absorb or otherwise preclude developments or intrusions between the two use areas.

2. A strip of undisturbed vegetation that retards the flow of runoff water, causing deposition of transported sediment and reducing sedimentation in the receiving stream.

CANOPY COVER. The percentage of ground area under an overstory vegetation that would not be impacted by raindrops falling straight down.

CASING. Steel pipe placed in a gas well to prevent the hole from caving.

CBM EMPHASIS AREA. For this environmental impact statement, the emphasis area is the Billings and Powder River RMP areas, and Blaine, Park, and Gallatin counties. This is the 16-county area within the BLM State and planning area where there is CBM development interest. See also **planning area**.

CHANNEL INTEGRITY (STABILITY). A relative term describing erosion or movement of the channel walls or bottom because of water flow.

CHECKERBOARD PATTERN. One in which ownership of sections of land alternates between federal and other ownership, usually private. On a map with different colors denoting type of ownership, the pattern resembles a checkerboard.

CLAYEY. A soil containing more than 35 percent clay. The textural classes are sandy clay, silty clay, clay, clay loam, and silty clay loam.

CLEAN AIR ACT. Public Law 84-159, established July 14, 1955, and amended numerous times since. The Clean Air Act: establishes federal standards for air pollutants emitted from stationary and mobile sources; authorizes states, tribes and local agencies to regulate polluting emissions; requires those agencies to improve air quality in areas of the country which do not meet federal standards; and to prevent significant deterioration in areas where air quality is cleaner than those standards. The Act also requires that all federal activities (either direct or authorized) comply with applicable local, state, tribal and federal air quality laws, statutes, regulations, standards and implementation plans. In addition, before these activities can take place in non-attainment or maintenance areas, the federal agencies must conduct a Conformity Analysis (and possible Determination) demonstrating the proposed activity will comply with all applicable air quality requirements.

CLOSED MUD SYSTEM. A drill mud system that reuses or reclaims all the drilling fluid used. Oil-based mud systems are often closed mud systems.

COAL BED METHANE. A clean-burning natural gas found deep inside and around coal seams. The gas has an affinity to coal and is held in place by pressure from groundwater. Mining for coalbed methane involves drilling into coal seams and discharging large volumes of groundwater to release the gas.

COLLUVIAL. Loose, incoherent geological deposits at the bottom of a slope or cliff, having fallen from above.

COMMUNITIZATION. The pooling of mineral acreages based on the spacing for a well or wells set by the state or BLM.

COMPACTION. The process of packing firmly and closely together; the state of being so packed; for example, mechanical compaction of soil by livestock or vehicular activity. Soil compaction results from particles being pressed together so that the volume of the soil is reduced. It is influenced by the physical properties of the soil, moisture content, and the type and amount of compactive effort.

COMPLETION. The activities and methods to prepare a well for production. Includes installation of equipment for production from a gas well.

CONDITION OF APPROVAL (COA). Conditions or provisions (requirements) under which an Application for a Permit to Drill or a Sundry Notice is approved.

CONTINENTAL DEPOSITS. A sedimentary deposit laid down on land (whether a true continent or only an island) or in bodies of water (whether fresh or saline) not directly connected with the ocean, as opposed to a marine deposit; a glacial, stream, lake, or windborne deposit formed in a nonmarine environment.

CONTROLLED SURFACE USE (CSU). Use or occupancy is allowed (unless restricted by another stipulation), but identified resource values require special operational constraints that may modify the lease rights. CSU is used for operating guidance, not as a substitute for the NSO or Timing stipulations.

CONVEYANCE LOSS. The percentage reduction in water volume between the time it is discharged to the surface and the time it reaches a perennial stream. This reduction in volume is due to the processes of infiltration and evaporation.

CORRIDOR. A strip of land through which one or more existing or potential facilities may be located.

CRUCIAL WINTER RANGE. That portion of the winter range on which a wildlife species is dependent for survival during periods of heaviest snow cover.

CULTURAL RESOURCE. A term that includes items of historical, archaeological, or architectural items; a remnant of human activity.

CUMULATIVE IMPACT. The impact on the environment that results from the positive or negative impacts of an action when added to other past, present, and reasonable foreseeable future actions, regardless of what agency or person performed such action(s).

DANCING GROUNDS. An area used in the spring by sharp-tailed grouse for courtship displays and breeding.

DECIBEL OR dB. A unit for measuring sound intensity, usually measured on the decibel A weighted scale (dBA) which approximates the sound levels heard by the human ear at moderate sound levels.

DECIVEW OR dV. A visual index appropriate for characterizing visibility through uniform hazes, designed to be linear with respect to perceived visual changes over its entire range (from pristine to polluted conditions) in a way that is analogous to the decibel scale for sound. The deciview haze index is calculated based on the logarithmic distribution of the extinction coefficient, where a 10.0 deciview change is about a 10 percent change in extinction coefficient; a small but perceptible scenic change under many circumstances ("just noticeable change").

DEEPER COAL SEAM. Designates a coal seam that is deep enough that it can be drilled to at a directional angle from a well pad in one spacing unit to another spacing unit. This avoids the need for constructing additional roads and well pads. The exact depth that the term "deeper" applies to is relative and will vary according to field spacing requirements and local geology.

DEVELOPMENT WELL. A well drilled in proven territory (usually within 1 mile of an existing well).

DISPOSAL WELL. A well into which produced water from other wells is injected into an underground formation for disposal.

DRAINAGE (GEOMORPHIC). A collective term for all the water bodies by which a region is drained; or, all the water features shown on a map.

DRAINAGE (OIL AND GAS). The uncompensated loss of hydrocarbons from Federal, Indian tribal or Indian-allotted mineral lands from wells on adjacent non-jurisdictional lands or jurisdictional lands with lower participation, allocation, royalty rate, or distribution of funds, resulting in revenue losses to the Federal or Indian lessors.

DRILL DIRECTIONALLY. The technique of drilling at an angle from a location at the surface to a different subsurface location at a specific target depth. The degree of angle that a well can be drilled is limited, which is why this technique is not employed for shallow coal seams.

DRILL RIG. The mast, drawworks, and attendant surface equipment of a drilling or workover unit.

DRILL STEM TEST. The use of a drill-stem testing tool to test a formations potential productivity. The tool is lowered to the formation and is packed off from the above formations. The tool is then operated to sample the formation and the results recorded. Also, called a formation test.

DROP STRUCTURE. An in-stream structure of various materials designed to reduce the energy and force of stream flow.

DRY HOLE. Any well incapable of producing oil or gas in commercial quantities. A dry hole may produce water, gas or even oil, but not enough to justify production.

ECOLOGICAL CONDITION. The present state of vegetation of a site in relation to the potential natural community for the site. Ecological status is use independent. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the potential natural community. Four ecological status classes correspond to 0-25, 26-50, 51-75, or 76-100 percent similarity to the potential natural community and are generally called early seral, mid-seral, late seral, and potential natural community, respectively.

ECOLOGICAL SITE. A kind of land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in its ability to produce vegetation and to respond to management.

ECOSYSTEM. A biological community, together with its nonliving environment, forming an interacting system inhabiting an identifiable space.

ELECTRICAL CONDUCTIVITY. A measure of the salt content of water.

EMERGENT AQUATIC VEGETATION. An aquatic plant having part of its vegetative parts above water.

EMISSION. Air pollution discharge into the atmosphere, usually specified by mass per unit time.

ENDANGERED SPECIES. Those species of plants or animals classified by the Secretary of the Interior or the Secretary of Commerce as endangered pursuant to Section 4 of the Endangered Species Act of 1973, as amended. See also Threatened and Endangered Species.

ENHANCED RECOVERY. The use of artificial means to increase the amount of hydrocarbons that can be recovered from a reservoir. A reservoir depleted by normal extraction practices usually can be restored to production by secondary or tertiary methods of enhanced recovery.

ENTRAINED PARTICULATES. Particulates contained within auto exhaust; mainly made of carbons.

EPHEMERAL STREAM. A stream that flows only after a storm or during snowmelt, and whose channel is, at all times, above the water table.

EPOCH. An interval of time based on similar rock formations and fossil groups. Used primarily as subdivisions of the Tertiary and Quaternary Periods.

EXPLORATION. Building a two-track road to drill test wells for coalbed methane. See also **development**.

EXPLORATION WELL. A well drilled in an area where there is no oil or gas production. Same as a "wildcat" well.

FAULT. A fracture surface in rocks along which movement of rock on one side has occurred relative to rock on the other side.

FLOODPLAIN. The relatively flat area or lowlands adjoining a body of standing or flowing water that has been or might be covered by floodwater.

FLOW LINE. A small diameter pipeline through which fluids move on lease before being sold.

FORAGE. Forms of vegetation available for animal consumption.

FORB. A broad-leaved herb that is not grass or grasslike.

FORMATION (GEOLOGIC). A rock body distinguishable from other rock bodies and useful for mapping or description. Formations may be combined into groups or subdivided into members.

FRAC FLOWBACK. During the drilling process, fluid or product returns along fractures in the rock to the point where it is difficult to control; for example, flowback from a point high in the borehole or at the ground surface away from the boring.

FUGITIVE DUST. Airborne particles emitted from any source other than through a controllable stack or vent.

GABIONS. A hollow cylinder of wickerwork or strap iron constructed like a basket, filled with stones and sunk to form a bar, dike, or similar structure.

GEOMORPHIC. Pertaining to the form of the earth or its surface features.

GROUND COVER. Vegetation, mulch, litter, or rocks.

GROUNDWATER. Subsurface water that is in the zone of saturation. The top surface of the groundwater is the "water table." Source of water for wells, seepage, and springs.

GULLYING. The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from the narrow area to considerable depths, ranging from 2 feet to as much as 80 to 100 feet deep.

GULLY PLUG. Any form of material placed in an existing gully to reduce the erosional effects of moving water and thereby starting a healing process of the gully.

HABITAT. In wildlife management, the major elements of habitat are considered to be food, water, cover, and living space.

HAZARDOUS WASTE. (A) Any substance designated pursuant to section 311(b)(2)(A) of the Federal Water Pollution Control Act. (B) Any element, compound, mixture, solution, or substance designated pursuant to section 102 of this Act. (C) Any hazardous waste having the characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress. (D) Any toxic pollutant listed under section 307(a) of the Federal Water Pollution Control Act. (E) Any hazardous air pollutant listed under section 112 of the Clean Air Act. (F) Any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to section 7 of the Toxic Substances Control Act. The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

HYDROGEN SULFIDE or H_2S. A colorless, highly flammable, and very toxic gas that smells like rotten eggs at low concentrations. At higher concentrations, the sense of smell is lost, therefore becoming impossible to perceive dangerous concentrations.

INFILTRATION. The flow of a fluid into a solid substance through pores or small openings; specifically, the movement of water into soil or porous rock.

INJECTION WELL. A well used to inject fluids into an underground formation to increase reservoir pressure.

INTERMITTENT STREAM. A stream that flows most of the time but occasionally is dry or reduced to pool stage when losses from evaporation or seepage exceed the available streamflow.

LAND AND WATER CONSERVATION FUNDS. Federal revenues generated by a tax on federal off-shore oil and gas development through the Land and Water Conservation Fund Act; used to acquire highly desirable lands for the United States by the various governmental agencies.

LEASABLE MINERALS. Federal minerals subject to lease under the Mineral Leasing Act of 1920, as amended, and supplemented. Includes minerals, such as oil, gas, coal, geothermal, tar sands, oil shale, potassium, phosphate, sodium, asphaltic materials.

LEASE.

1. A legal document that conveys to an operator the right to drill for oil and gas.

2. The tract of land, on which a lease has been obtained, where producing wells and production equipment are located.

LEASE NOTICE. Provides more detailed information concerning limitations that already exist in law, lease terms, regulations, or operational orders. A lease notice also addresses special items the lessee should consider when planning operations, but does not impose new or additional restrictions. Lease notices attached to leases should not be confused with NTLs (Notices to Lessees).

LEK. A traditional breeding area for grouse species where territorial males display and establish dominance.

LIGNITE. A brownish-black coal that is intermediate between peat and subbituminous coal.

LITHIC SCATTER. The waste material, chips, and flakes resulting from stone tool manufacture.

LOAMY. Soil that is intermediate in texture and properties between sandy and clayey soils. Textural classes are sandy loam, fine sandy loam, very fine sandy loam, loam, silt loam, sandy clay loam, and clay loam with clay content between 18 and 35 percent.

LOCALITY. The area where paleontologic material is discovered.

LOCATABLE MINERALS. Minerals or materials subject to disposal and development through the Mining Law of 1872 (as amended). Generally includes metallic minerals such as gold and silver and other materials not subject to lease or sale.

MESIC AREA. A habitat having a moderate amount of moisture available for the support of plant life.

MINERAL MATERIALS. Widespread deposits of common clay, sand, gravel, or stone that are not subject to disposal under the 1872 Mining Law, as amended.

MITIGATION MEASURES. Methods or procedures developed for the purpose of reducing or lessening the impacts of an action.

MONITORING. Specific studies that evaluate the effectiveness of actions taken toward achieving management objectives.

NATIONAL AMBIENT AIR QUALITY STANDARDS OR NAAQS. The allowable concentrations of air pollutants in the air specified by the federal government. The air quality standards are divided into primary standards (based on air quality criteria and allowing an adequate margin of safety requisite to protect the public health) and secondary standards (based on air quality criteria and allowing an adequate margin of safety to protect the public welfare from any unknown or expected adverse effects of air pollutants).

NO SURFACE OCCUPANCY. Use or occupancy of the land surface for fluid mineral exploration or development is prohibited to protect identified resource values.

NOTICE TO LESSEES (NTL). The NTL is a written notice issued by the Authorized Officer. NTLs implement regulations and operating orders, and serve as instructions on specific item(s) of importance within a State, District, or Area.

PARENT MATERIAL. The unconsolidated and chemically-weathered mineral or organic matter from which the horizons of soils develop by natural processes.

PARTICULATE MATTER. A particle of soil or liquid matter (e.g., soot, dust, aerosols, fumes and mist).

PERENNIAL STREAM. A permanent stream that flows 9 months or more out of the year.

PERMEABILITY. The ease with which gases, liquids or plant roots pass through a layer of soil. Accepted as a measure of this property is the rate at which soil transmits water while saturated, and may imply how well water passes through the least permeable soil layer.

pH. A measure of acidity or alkalinity. A solution with a pH of 7 is neutral, pH greater than 7 (to 14) is alkaline, and a pH less than 7 (to 0) is acidic.

POST-FLPMA LEASES. Oil and gas leases issued after the passage of the Federal Land Policy and Management Act of 1976. Where occurring in Wilderness Study Areas, these leases have no valid existing rights and could not impair wilderness values.

POTENTIAL NATURAL COMMUNITY. The biotic community that would become established if all successional sequences were completed without interferences under the present environmental conditions.

PARTS PER MILLION (PPM). A measurement to identify the amount of particulates in air or water.

POD. Describes the general location of a series of wells that tap individual coal seams within a single 80-acre spacing unit. For example, within the Powder River Basin, three coal seams are layered beneath the surface. On the surface, an operator may drill three separate wells to different depths to tap these individual seams. The wells may be located within 20 feet of each other, representing a pod of wells.

PRAIRIE DOG COLONY COMPLEX. A group of prairie dog colonies distributed so that individual black-footed ferrets can migrate among them commonly and frequently. This distance has been determined to be 7 kilometers (4.4 miles).

PRE-FLPMA LEASES. Oil and gas leases issued prior to the passage of the Federal Land Policy and Management Act of 1976. Where occurring in Wilderness Study Areas, these leases have valid existing rights which allow development even if wilderness values may be impaired.

PREVENTION OF SIGNIFICANT DETERIORATION OR PSD. A regulatory program under the Clean Air Act (Public Law 84-159, as amended) to limit air quality degradation in areas currently achieving the National Ambient Air Quality Standards. The PSD program established air quality classes in which differing amounts of additional air pollution is allowed above a legally defined baseline level. Almost any additional air pollution would be considered significant in PSD Class I areas (certain large national parks and wilderness areas in existence on August 7, 1977, and specific Tribal lands redesignated since then). PSD Class II areas allow that deterioration associated with moderate, well-controlled growth (most of the country).

Class I. An area that allows only minimal degradation above "baseline." The Clean Air Act designated existing national parks over 6,000 acres and national wilderness areas over 5,000 acres in existence on August 7, 1977, as mandatory Federal Class I Areas. These areas also have special visibility protection. In addition, four tribal governments have redesignated their lands as Class I Areas.

Class II. An area that allows moderate degradation above "baseline." Most of the United States (outside nonattainment areas) is Class II.

Class III. Any area that allows the maximum amount of degradation above "baseline." Although the U.S. Congress allows air quality regulatory agencies to redesignate Class II lands to Class III, none have been designated.

PRODUCED WATER. Water produced from oil and gas wells.

RAPTOR. Bird of prey with sharp talons and strongly curved beaks (hawks, falcons, owls, and eagles).

RECLAMATION. Rehabilitation of a disturbed area to make it acceptable for designated uses. This normally involves regrading, replacement of topsoil, revegetation, and other work necessary to restore it for use.

RESERVE PIT.

1. Usually an excavated pit that may be lined with plastic, that holds drill cuttings and waste mud.

2. Term for the pit that holds the drilling mud.

RIGHT-OF-WAY GRANT. A document authorizing a nonpossessory, nonexclusive right to use federal lands for the limited purpose of construction, operation, maintenance, and termination of a pipeline, road, or powerline.

RILL. Small, conspicuous water channel or rivulet that concentrates runoff; usually less than 6 inches deep.

RIPARIAN/WETLAND AREA. An area of land directly influenced by permanent water. It has visible vegetation or physical characteristics reflective of permanent water influence. Lakeshores, streams and permanent springs are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.

ROAD. A vehicle route that has either been improved and maintained by mechanical means to ensure relatively regular and continuous use, or been established where vehicle travel has created two parallel tracks lacking vegetation.

SALINITY. A measure of the salts dissolved in water. See **alkalinity**.

SEDIMENT. Soil, rock particles and organic or other debris carried from one place to another by wind, water, gravity, ice, or other geologic agent.

SEDIMENTARY ROCK. A layered rock resulting from the consolidation of sediment, such as shale, sandstone, and limestone.

SEISMIC OPERATIONS. Use of explosive or mechanical thumpers to generate shock waves that can be read by special equipment to give clues to subsurface conditions.

SERAL COMMUNITY. One of a series of plant communities that follow one another in time on any given area.

SERAL STAGE. A potential plant community made up of a mix of trees and shrubs.

SHALLOW COAL SEAM. Those coal seams that are too shallow to drill to directionally given the area geology and spacing limitations.

SHEET EROSION. The detachment of soil material from the land surface by raindrop impact and its subsequent removal by runoff.

SHUT IN. To close the valves on a well so it ceases production.

SHRUB. A low, woody plant, usually with several stems; may provide food and/or cover for wildlife.

SODIUM ADSORPTION RATIO. An expression of relative activity of sodium ions in exchange reactions with soil, indicating the sodium or alkali hazard to soil. It is a particularly important measure in waters used for irrigation purposes.

SODIUM-AFFECTED SOIL. A nontechnical term for sodic soil (also called alkali soil) that contains sufficient sodium to interfere with the growth of most crop plants and in which the exchangeable sodium percentage is 15 or higher. It is also a generic way of describing nonsaline-alkali soil or saline-alkali soil.

SOIL DEPTH CLASSES. Classes overlap from 0 to 60 or more inches with specific depths as follows: very shallow 0-10 inches, shallow from 5-30 inches, moderately deep from 20-50 inches, deep from 30-60 inches, and very deep from 50 to more than 60 inches.

SOIL SERIES. The lowest category of soil classification, being a subdivision of a family and consisting of soils which are essentially alike in all major profile characteristics except in the texture of the "A" horizon (or surface layer).

SOIL SURVEY. The systematic examination, description, classification, and mapping of soils in an area, usually a county. Soil surveys are classified according to the level of detail of field examination. Order I is the most detailed, then Order II, on to Order V which is the least detailed. Most BLM soil surveys are Order II or III.

SOLID WASTE. Any solid, semi-solid, liquid, or contained gaseous material that is intended for disposal.

SOUR WELL. A condition caused by the presence of hydrogen sulfide in an oil or gas well.

SPACING UNIT. The number of acres that one oil or gas well will efficiently drain. The Montana Oil and Gas Commission establishes the size of spacing units for each oil and gas field.

SPECIES OF SPECIAL INTEREST OR CONCERN. Animals not yet listed as endangered or threatened but that are undergoing status review by a federal or state agency. This may include animals whose populations could become extinct by any major habitat change. A species that is particularly sensitive to some external disturbance factors.

SPLIT ESTATE. Surface and minerals of a given area in different ownerships. Frequently, the surface is privately-owned while the minerals are federally-owned.

SPUDDING. To begin drilling; to start the hole.

STEEP SLOPE. Slope greater than 30 percent.

STEP OUT WELL. A well drilled some distance from a proven well to determine the limits of the oil or gas reservoir.

STIPULATION. A condition or requirement attached to a lease or contract, usually dealing with protection of the environment, or recovery of a mineral.

STRUCTURAL IMPROVEMENTS. Improvements such as fences, reservoirs, springs, pipelines, waterspreaders, wells, water troughs, land treatments and instream structures. These improvements are for the livestock grazing, wildlife, recreation, watershed and soils programs.

STRUTTING GROUND. An area used in the spring by sage grouse for courtship displays and breeding. Synonymous with the term "lek."

SUBBITUMINOUS. A black coal, intermediate in rank between lignite and bituminous coal. Distinguished from lignite by higher carbon and lower moisture content.

SULFUR DIOXIDE OR SO_2. A colorless gas formed when sulfur oxidizes, often as a result of burning trace amounts of sulfur in fossil fuels.

SWEET WELL. An oil or gas well lacking any significant amounts of hydrogen sulfide.

SYNCLINES. A downward, trough-shaped configuration of folded, stratified rocks.

TERRACE DEPOSITS. A terrace is one of a series of level surfaces in a stream valley, flanking and more or less parallel to the stream channel. It is above the level of the stream, and represents the dissected remnants of an abandoned flood plain, stream bed, or valley floor produced during a former stage of erosion or deposition.

TOTAL DISSOLVED SOLIDS (TDS). The dry weight of dissolved material, organic and inorganic, contained in water.

TMDL (Total Maximum Daily Load). A TMDL is the total amount of a pollutant that a water body may receive from all sources without exceeding water quality standards. A TMDL can also be defined as a reduction in pollutant loading that results in meeting water quality standards. The TMDL process was established under Section 303(d) of the Clean Water Act. A TMDL includes both a waste load allocation, which focuses on point sources, and a load allocation, which addresses non-point sources.

TRANSMISSION LINE. A large diameter pipeline through which oil or gas moves off lease after being sold.

TURBIDITY. An interference to the passage of light through water due to insoluble particles of soil, organic material, micro-organisms, and other materials.

UNDERGROUND INJECTION CONTROL PROGRAM. A program administered by the Environmental Protection Agency, primacy State, or Indian Tribe under the Safe Drinking Act to ensure that subsurface waste injection does not endanger underground sources of drinking water.

UNDERSTORY VEGETATION. Plants, usually grasses, forbs, and low shrubs, growing beneath the canopy of other plants.

UNITIZATION. Pooling of mineral acreages proposed by a company to facilitate the efficient development of a reservoir based on geology and reservoir characteristics of a producing formation or formations.

UNNECESSARY OR UNDUE DEGRADATION. Conditions, activities, or practices that:

> (1) Fail to comply with one or more of the following: The performance standards in Sec. 3809.420 (43 CFR), the terms and conditions of an approved plan of operations, operations described in a complete notice, and other Federal and State laws related to environmental protection and protection of cultural resources;
>
> (2) Are not "reasonably incident" to prospecting, mining, or processing operations as defined in Sec. 3715.0-5 of this title;
>
> (3) Fail to attain a stated level of protection or reclamation required by specific laws in areas such as the California Desert Conservation Area, Wild and Scenic Rivers, BLM-administered portions of the National Wilderness System, and BLM-administered National Monuments and National Conservation Areas; or
>
> (4) Occur on mining claims or millsites located after October 21, 1976 (or on unclaimed lands) and result in substantial irreparable harm to significant scientific, cultural, or environmental resource values of the public lands that cannot be effectively mitigated.

USABLE WATER. Those waters containing up to 10,000 parts per million of total dissolved solids.

VIEWSHED. Landscape that can be directly seen under favorable atmospheric conditions, from a viewpoint or along a transportation corridor.

WATER QUALITY. The chemical, physical, and biological characteristics of water with respect to its suitability for a particular use.

WATERSHED. All lands which are enclosed by a continuous hydrologic drainage divide and lie upslope from a specified point on a stream.

WELL COMPLETION. See **completion**.

WELL LIFE. For the purposes of this plan the well life is defined as from the time the well is drilled until the final abandonment of the well is approved.

WETLANDS. Permanently wet or intermittently flooded areas where the water table (fresh, saline, or brackish) is at, near, or above the soil surface for extended intervals; where hydric wet soil conditions are normally exhibited, and where water depths generally do not exceed two meters.

WILDCAT. A well drilled in an area where no oil or gas production exists.

WILDCAT WELL. An exploratory well drilled in an area where there is no oil or gas production (see exploration well).

WILDERNESS STUDY AREA (WSA). An area deter-mined to have wilderness characteristics. WSAs are submitted to the President and Congress for wilderness designation. These areas are an interim designation, valid until either designated as wilderness or released to multiple-use management.

WORKOVER. To perform one or more remedial operation on a producing well to increase production. Deepening, plugging back, pulling, and resetting the liner are examples of workover operations.

BIBLIOGRAPHY

Admin report BIA-3
1975. Status of Mineral Resource Information for the Northern Cheyenne Indian Reservation, Montana Administrative Report BIA-3.

Admin report BIA-7
1975. Status of Mineral Resource Information for the Crow Indian Reservation, Montana Administrative Report BIA-7.

Advanced Resources International
2002. Memorandum to Peter Lagiovanne, "CBM-Type Wells for the Powder River Basin" June 2002.

Agnew, W.
1983. Flora and fauna associated with prairie dog ecosystems. M.S. Thesis. Colorado State University, Fort Collins, CO.

Agnew, W., D.W. Uresk, and R.M. Hansen
1986. Flora and Fauna Associated with Prairie Dog Colonies and Adjacent Ungrazed Mixed-Grass Prairie in Western South Dakota. *J. Range Manage.* 39:135-139.

ALL
2001a. Soils Technical Report, Montana statewide oil and gas environmental impact statement and amendment of the Powder River and Billings resource management plans. Prepared for the U.S. Department of the Interior, Bureau of Land Management, Miles City Field Office. ALL Consulting, Tulsa, OK.

ALL
2001b. Water Resources Technical Report, Montana statewide oil and gas environmental impact statement and amendment of the Powder River and Billings resource management plans. Prepared for the U.S. Department of the Interior, Bureau of Land Management, Miles City Field Office. ALL Consulting, Tulsa, OK.

Allen, K. L., T. Weaver, and D. Flath
1994. Small mammals in Northern Rocky Mountain ecosystems. Unpubl. report to Bureau of Land Management and United States Forest Service, August 31, 1994. Montana State University, Bozeman, MT.

American Ornithologists' Union (AOU)
1983. Checklist of North American birds, 6th ed. American Ornithologists' Union, Washington, D.C.

Anderson, D.W. and J.O. Keith
1980. "The human influence on seabird nesting success: Conservation implications." Biological Conservation 18:65-80.

AOU
See American Ornithologists' Union.

Applied Hydrology Associates
2001. Cumulative Impacts of Coal Bed Methane Development on Water Quality in the Powder and Little Powder Rivers. August 16, 2001.

Argonne National Laboratory
2002. Air Quality Impact Assessment Technical Support Document, Montana Statewide EIS/RMP Amendment of the Powder River and Billings Resource Management Plans. Prepared for the U.S. Department of the Interior, Bureau of Land Management, Montana State Office.

Argonne National Laboratory
2002. Preliminary Draft Technical Support Document—Air Quality Impact Assessment for the Montana Statewide Final Oil and Gas EIS and Amendment of the Powder River and Billing Resource Management Plans and the Wyoming Final EIS and Planing Amendment for the Powder River Basin Oil and Gas Development Project. Prepared for the U.S. Department of the Interior, Bureau of Land Management, Montana and Wyoming State Offices, by the Environmental Assessment Division, Argonne National Laboratory, Argonne, IL.

ARI, Inc.
2002. PRB Reservoir Performance Model, report by Advanced Resources International, Inc. for US DOE, May, 2002.

Armstrup, S.
1978. Activities and habitat use of pronghorns on Montana-Wyoming coal lands. Proc. Bienn. Pronghorn Ant. Workshop 8:270-306.

Autenrieth, R.E.
1981. Sage grouse management in Idaho. Wildl. Bull. 9. Idaho Dep. Fish and Game, Boise.

Ayers and Westcot
1985. Ayers, R.S., and D.S. Westcot, 1985 Water Quality for Agriculture, FAO Paper 29, Rev.1.Rome.

Bauder, J.
2001. Final Report. Recommended In-Stream Standards, Thresholds, and Criteria for Irrigation or Water Spreading to Soils of Alluvial Channels, Ephemeral Streams, Floodplains, and Potentially Irrigable Parcels of Land Within the Boundaries of the Northern Cheyenne Reservation.

Bauder, J.
1998. Salt problems common in Montana soils. MSU Extension Publication Newsletter. Bozeman, MT.

Bauder, J.
1999. Coal Bed Methane Gas and Montana Water Quality. Unpublished document. Extension Soil and Water Quality Specialist, Montana State University. Bozeman, Montana.

Bauder, J.W.
2001. Recommended in-stream standards, thresholds and criteria for irrigation or water spreading to soils of alluvial channels, ephemeral streams, flood plains, and potentially irrigable parcels of land within the boundaries of the Northern Cheyenne Reservation. Montana State University. Bozeman, MT.

Bayless, S.
1967. Winter range use of pronghorn antelope in central Montana. M.S. thesis. Montana State University, Bozeman, MT.

Bell, M.C.
1986. *Fisheries handbook of engineering requirements and biological criteria.* Fish Passage Development and Evaluation Program. U.S. Army Corps of Engineers.

Berry, J.D., and R.L. Eng
1985. Interseasonal movements and fidelity to seasonal use areas by female Sage Grouse. J. Wildl. Manage. 49:237-240.

BIA
See U.S. Bureau of Indian Affairs.

Billings Gazette
2001. "Readers Weigh in on Coalbed Methane." *Billings Gazette.* February 25, 2001.

Bjornn, T.C., and D.W. Reiser
1991. "Habitat requirements of salmonids in streams." In *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats*. William R. Meehan, ed., U.S. Department of Agriculture, Forest Service. American Fisheries Society Special Publication 19. Bethesda, MD.

Blend, J.
2001. Personal communication between Jeff Blend/Montana Department of Environmental Quality and Tim Burkhardt/CH2M HILL, April 4, 2001.

BLM
See USDI Bureau of Land Management.

BOGC
See Montana Board of Oil and Gas Conservation.

Bohman, R.
2001. Personal communication between Jon W. Seekins and Mr. Bohman, MDEQ, August 2001.

Bradbury, J. W., R. M. Gibson, C. E. McCarthy, and S.I. Vehrencamp
1989. Dispersion of displaying male sage grouse. II. The role of female dispersion. Behavioral Ecology and Sociobiology 24:15-24.

Brady, N. C.
1990. The nature and properties of soils. New York, McMillan Publishing Co., p. 47.

Brittangham, M.C. and S.A. Temple
1983. "Have cowbirds caused forest songbirds to decline?" Bioscience, 33:31-35.

Bruns, E.H.
1977. "Winger behavior of pronghorns in relation to habitat." *Journal of Wildlife Management*. 41:560-571.

Busack, S.D. and R.B. Bury
1974. "Some effects of off-road vehicles and sheep grazing on lizard populations in the Mojave Desert." *Biological Conservation*. 6(3):179-83.

Calvert, W.R.
1912a. The Livingston and Trail Creek Coal Fields, Park, Gallatin, and Sweetgrass Counties, Montana. In Contributions to Economic Geology 1910. U.S. Geological Survey Bulletin 471.

Calvert, W.R.
1912b. The Electric Coal Field, Park County, Montana. In Contributions to Economic Geology 1910. U.S. Geological Survey Bulletin 471.

Campbell, T. M., III, and T. W. Clark
1981. Colony characteristics and vertebrate associations of white-tailed and black-tailed prairie dogs in Wyoming. *Amer. Midl. Nat.* 105:269-276.

Campen, E. and J. R. Gruber
1991. Coal and Coalbed Methane Resources of Montana, Rocky Mountain Association of Geologists.

Campen, B.
1990. Exploring the coalbeds of Montana. *Western Oil World.* Pp. 24-26.

Case, J.C., T. V. Edgar, and R. H. DeBruin
2000. *"Subsidence potential related to water withdrawal in the Powder River Basin,"* Wyoming State Geological Survey, Wyoming Geonotes (Number 68, December).

Chamberlin, T.W., R.D. Harr, and F.H. Everest
1991. "Timber harvesting, silviculture, and watershed processes." In *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats.* William R. Meehan, ed., U.S. Department of Agriculture, Forest Service. American Fisheries Society Special Publication 19. Bethesda, MD.

Chappell, K.
2001. Personal communication between K. Chappell/Agriculture and Grazing Bureau Chief, Department of Natural Resources and Conservation, Helena, MT with David Epperly/ALL Consulting. April 23, 2001.

Choate, Raoul, C.A. Johnson, and J.P. McCord
1984. Geologic overview, coal deposits, and potential for methane recovery from coalbeds—Powder River Basin. Rightmire, C.T., Eddy, G.E., and Kirr, J.N., eds., *Coalbed methane resources of the United States: AAPG Studies in Geology.* Ser. 17. Pp. 335-351.

Clark, T. W., T. M. Campbell III, D. G. Socha, and D. E. Casey
1982. "Prairie dog colony attributes and associated species." *Great Basin Nat.* 42:572-582.

Clark, T. W., A. H. Harvey, R. D. Dorn, D. L. Genter, and C. Groves, eds.
1989. Rare, sensitive, and threatened species of the Greater Yellowstone Ecosystem. Northern Rockies Conservation Cooperative, Montana Natural Heritage Program, The Nature Conservancy, and Mountain West Environmental Services.

Clark, W.F., Hemler, T.
1992. Completing, equipping, and operating Fruitland Formation coal-bed methane wells in the San Juan Basin, New Mexico and Colorado. In Society of Petroleum Engineers. Coalbed methane. Soc. Petro. Eng., Richardson, TX. SPE Reprint Ser. No. 35. pp. 112-119.

CMS
2000. Presentation to the Coal Bed Methane Coordination Group on October 18, 2000.

Coal Bed Methane Coordination Group
2000. CMS Energy Presentation, Coal Bed Methane Coordination Group, October 18, 2000.

Cole, E.K., M.D. Pope, and R.G. Anthony
1997. "Effects of road management on movement and survival of Roosevelt elk." *Journal of Wildlife Management.* 61:1115-1126.

Connelly, J. W., and C. E. Braun
1997. Long-term changes in sage grouse *Centrocercus urophasianus* populations in western North America. *Wildlife Biology*. 3/4:123-128.

Connelly, J. W., H. W. Browers, and R. J. Gates
1988. Seasonal movements of sage grouse in southeastern Idaho. *Journal of Wildlife Management*. 52:116-122.

Connelly, J. W., and O.D. Markham
1983. Movements and radionuclide concentrations of sage grouse in southeastern Idaho. *Journal of Wildlife Management*. 47:169-177.

Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun
2000. Guidelines to manage sage grouse populations and their habitats. *Wildlife Society Bulletin*. 28(4)967-985.

Coplen, T. B.
1994. "Reporting of stable hydrogen, carbon, and oxygen isotopic abundances." *Pure Appl. Chem*. 66, 273-276.

Council on Environmental Quality (CEQ)
2002. CEQ NEPAnet: Guidance for preparing documents under the National Environmental Policy Act. http://ceq.eh.doe.gov/nepa/nepanet.htm. Executive Office of the President, Washington, D.C. <September 10, 2002>.

Coyner, J.
1989. Status check on reported historic populations of *Spiranthes diluvialis*. Memorandum, U.S. Fish and Wildlife Service, Salt Lake City, UT.

Coyner, J.
1990. Report for population study *Spiranthes diluvialis*. Unpublished report. Bureau of Land Management and Red Butte Gardens, University of Utah, Salt Lake City, UT.

Crockett, F.
2001. DOI, BLM, RMG Casper, WY, personal communication between Fred Crockett, Casper BLM, and Charles Laakso, MCFD, February 2001.

Crockett, F. and J. Meyer
2001. Update and revision of interim drainage report on coalbed methane development and drainage of federal land in the South Gillette area, Campbell and Converse counties, Wyoming. T. 40-50 N., R 70-75 W. BLM Wyoming State Office-Reservoir Management Group. Casper Field Office. Casper, WY.

Crow Tribe of Indians, Crow Conservation District, Big Horn Conservation District, and USDA Natural Resources Conservation Service
1997. Crow Tribe and Big Horn County Resource Assessment.

Crow Tribe of Indians
1999. Application to EPA for Water Quality Standards Program, Draft, Crow Indian Reservation, Crow Agency, Montana.

Crow Tribe of Indians
2002. Crow Indian Reservation: Crow Natural, Socio-Economic, and Cultural Resources Assessment and Conditions Report, April 2002. Crow Agency, MT. 104 p.

Dalke, P. D., D. B. Pyrah, D. C. Stanton, J. E. Crawford, and E. F. Schlatterer.
1963. Ecology, productivity, and management of sage grouse in Idaho. *Journal of Wildlife Management*. 27:810-841.

Darrow, G.
1954. The Bearcreek coal field. Richards, P.W., ed., *Pryor Mountains-Northern Bighorn Basin, Montana Fifth Annual Field Conference: Billings Geological Society Guidebook, September 9-11, 1954*. Pp. 130-132.

Davis, L.
1995. A handbook of constructed : a guide to creating wetlands for: agricultural waste, wastewater, domestic wastewater, coal mine drainage, stormwater in the Mid-Atlantic Region. Vol. 1. General considerations. U.S. Environmental Protection Agency, Wash., D.C. 46 p.

DeWalle, D.R.; Galeone, D.G.
1990. One-time dormant season application of gas well brine on forest land. J. Environ. Qual. 19:288-295.

Dwight's Well Data
2001. Petroleum Information/Dwights LLC, www.pidwights.com. The site may contain the copyrighted property of HIS Energy Group, © 2001, HIS Energy Group, All Rights Reserved.

Egoscur, H.J.
1979. Vulpes velox. Mammalian Species 122:1-5.

Ellis, M.S., G.D. Stricker, R.M. Flores, and L.R. Bader.
1998. Sulfur and ash in Paleocene Wyodak-Anderson coal in the Powder River Basin, Wyoming and Montana, Proc. 23rd Internl. Tech. Conf. on Coal Utilization, March 1998.

Ellis, M.S., G.L. Gunther, A.M. Ochs, S.B. Roberts, E.M. Wilde, J.H. Schuenemeyer, H.C. Power, G.D. Stricker, and D. Blake
1999. Coal resources, Powder River Basin. In: U.S. Geological Survey Professional Paper 1625-A.

Ellis, M.S., G.L. Gunther, R.M. Flores, A.M. Ochs, G.D. Stricker, S.B. Roberts, T.T. Taber, L.R. Bader, and J.H. Schuenemeyer.
1999b. Preliminary report on coal resources of the Wyodak-Anderson coal zone, Powder River Basin, Wyoming and Montana, U.S. Geological Survey Open-File Report 98-789A.

Elser, A. A., Mark W. Gorges, and Lani M. Morris
1980. Distribution of fishes in southeastern Montana. Cooperatively compiled by Montana Department of Fish, Wildlife and Parks and the U.S. Department of the Interior, Bureau of Land Management. Revised edition, October 1980.

Energy Laboratories, Inc.
2001. Whole Effluent Toxicity Testing Results of Tongue River Produced Water. Billings, Montana. March 2001.

Eng, R. L. and P. Schladweiler
1972. "Sage grouse winter movements and habitat use in Central Montana." *Journal of Wildlife Management.* 36(1):141-146.

Environmental News Network.
2001. Coalbed methane boom in Wyoming's Powder River Basin. ENN, Thursday, Oct. 18, 2001.

Estes, J. R., R. J. Tyrl, and J. N. Brunken, eds.
1982. Grasses and grasslands: systematics and ecology. University of Oklahoma Press, Norman, OK. 312 pp.

Eustace, C.
2001. Montana Fish, Wildlife, and Parks, personal communication with Chuck Blair, September 2001.

Evans, D. L.
1982. Status reports on twelve raptors. U.S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report No. 238.

Federal Register
1983. Volume 48, Number 41, Department of Interior Part III. National Registry of Natural Landmarks, National Park Service, Public Notice. pp-8682-8704. March 1, 1983.

Fernandez, C.
1993. "The choice of nesting cliffs by golden eagles Aquila chrysaetos: the influence of accessibility and disturbance by humans." Alauda. 61:105-110.

Fidelity
2001. Personal Communication with Mr. Bruce Williams of Fidelity Exploration and Production Company, Regarding coal dust suppression and the use of CBM produced water, August 2001.

Fischer, R. A., A. D. Apa, W. L. Wakkinen, K. P. Reese, and J. W. Connelly
1993. Nesting-area fidelity of sage grouse in southeastern Idaho. Condor 95:1038-1041.

Fischer, R. A.
1994. The effects of prescribed fire on the ecology of migratory sage grouse in southeastern Idaho.

Fisher, F. B., J. C. Winne, M. M. Thornton, T. P. Tady, Z. Ma, M. M. Hart, and R. L. Redmond
1998. Montana land cover atlas. Unpublished report. Montana Cooperative Wildlife Research Unit, The University of Montana, Missoula, MT.

Flath, D. L.

1991. Species of special interest or concern (draft report). Montana Department of Fish, Wildlife and Parks.

Flores, R.M. and L.R. Bader.

1999. Fort Union coal in the Powder River Basin, Wyoming and Montana: a Synthesis, in USGS Prof. Paper 1625-A.

Flores, R., G. Stricker, J. Meyer, T. Doll, P. Norton, R. Livingston, and M. Jennings

2001. A Field Conference on Impacts of Coal Bed Methane Development in the Powder River Basin, Wyoming, USGS Open-File Report 01-126.

Fort Belknap Indian Community

2001. Fort Belknap Indian Community Web Page. http://www.mnisose.org/profiles/ftbelnp.htm. <April 25, 2001>.

Fox, Douglas G.; Bartuska, Ann M.; Byrne, James G; and others

1989. A screening procedure to evaluate air pollution effects on Class I wilderness areas/ Gen. Tech. Rep. RM-168. Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO.

Free Indian News Web page

2001. http://www.freeindiannews.com/page1085.html, Crow Tribal Information.

Furniss, M.J., T.D. Roelofs, and C.S. Yee

1991. "Road construction and maintenance." In *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats.* William R. Meehan, ed., U.S. Department of Agriculture, Forest Service. American Fisheries Society Special Publication 19. Bethesda, MD.

FWS

See USDI, Fish and Wildlife Service.

Fyfe, R.W. and R.R. Olendorff

1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Canadian Wildlife Service, Information Canada. Catalogue No. CW69-1/23. Ottawa.

Gates, R.J.

1983. Sage grouse, lagomorph and pronghorn use of a sagebrush-grassland burn site of the Idaho National Engineering Laboratory. M.S. Thesis, Montana State Univ., Bozeman, MT.

Gibbs, J.P.

1998. "Amphibian movements in response to forest edges, roads, and streambeds in southern New England." *Journal of Wildlife Management*. 62(2):1998.

Gill, R.B.

1965. Distribution and abundance of a population of sage grouse in North Park, Colorado. M.S. Thesis, Colorado State Univ. Fort Collins, CO.

Gray, I.

1987. Reservoir Engineering in Coal Seams: Part 1 – The Physical Process of Gas Storage and Movement in Coal Seams, SPERE, pp. 28-34, February, 1987.

Greystone

2002. Surface Water Quality Analysis Technical Report, Denver, Colorado, November 2002.

Groot Bruinderink, G.W.T.A. and E. Hazebroek

1996. "Ungulate traffic collisions in Europe." *Conservation Biology*. 10:1059-1067.

Grover, K.E. and M.J. Thompson

1986. "Factors influencing spring feeding site selection by elk in the Elkhorn Mountains, Montana." *Journal of Wildlife Management*. 50:466-470.

Gutzwiller, K.J.

1991. Assessing recreational impacts on wildlife: The value and design of experiments. Transactions of the 56th North American Wildlife and Natural Resources Conference. 248-255.

Haas, L.

2001. Personal communication between Laurie Haas, Resources Assistant/BLM Butte Field Office, and Dr. David Epperly/ALL Consulting, June 22, 2001.

Hamlin, K. L.
1978. Population ecology and habitat relationships of mule deer and white-tailed deer in the prairie agricultural habitats of eastern Montana, Montana Deer Studies. Montana Department of Fish, Wildlife and Parks. Project W-120-R-10, Job Progress Report.

Hanf, J. M., P. A. Schmidt, and E. B. Groshens.
1994. Sage grouse in the high desert of central Oregon: results of a study, 1988-1993. U.S. Department of Interior, Bureau of Land Management Series P-SG-01, Prineville, Oregon. 56 p.

Hansen, J.
2001. Personal communication via email between J. Hansen/Montana Department of Fish, Wildlife and Parks (MFWP) and J. Ferguson/CH2M HILL. April 4, 2001.

Heffern, E. L.
1999. Methane Seepage and Coal Fires. Unpublished Report for Wyodak CBM Project EIS. Prepared for BLM Buffalo Field Office, Buffalo, WY.

Heffern, E. L., D. A. Coates, and C. W. Naeser
1983. Distribution and age of clinker in the northern Powder River Basin, Montana. American Association of Petroleum Geologist Bulletin. V. 67. no. 8.

Hendricks, P., and J. D. Reichel
1996. Preliminary amphibian and reptile survey of the Ashland District, Custer National Forest: 1995. Montana Natural Heritage Program. Helena, MT.

Herco-Hampton
1989. Northern Cheyenne Coalbed Methane Project. Billings, MT.

Hill, D. G., et al.
2000. "Coalbed methane in the Rocky Mountain region: the old, the new, and the future." In: *Proceedings of the RMAG Conference on Coalbed Methane in the Rocky Mountains.* June 20-21, 2000. Denver, CO.

HKM Associates
1972. Inventory of Water Resources, Northern Cheyenne Indian Reservation, Phase I – Water Resource Base: Billings, Montana.

HKM Associates.
1973. Report on Inventory of Water Resources, Northern Cheyenne Indian Reservation, Montana, Off-Stream Storage Supplement to Phase I—Water Resource Base: Billings, Montana. May 1973.

HKM Associates
1982. Shallow Ground Water Study, Northern Cheyenne Indian Reservation, Montana, Part I-Ground Water Basic Data, Northern Cheyenne Indian Reservation: Billings, Montana.

Hodson, W.G., R.H. Pearl, S.A. Druse.
1973. Water resources of the Powder River Basin and adjacent areas, Northeastern Wyoming. USGS Hydrologic Invest. Atlas HA-A65.

Hoffmann, R. S., and D. L. Pattie
1968. A guide to Montana mammals: identification, habitat, distribution, and abundance. University of Montana, Missoula, MT.

Hopkins, R. B.
1984. "Avian species associated with prairie woodland types." *In*: Wooded draws: characteristics and values for the northern Great Plains. Daniel L. Noble and Robert R. Winokur, eds. Symposium proceedings, June 12 and 13, 1984. Great Plains Council Publication 111. South Dakota School of Mines and Technology, Rapid City, SD.

Horpestad, A., D. Skaar, and H. Dawson
2001. Water Quality Technical Report: Water Quality Impacts from Coal Bed Methane Development in the Powder River Basin, Wyoming and Montana, Montana DEQ, Montana Fish Wildlife and Parks, and EPA Region 8.

Houtcooper, W. C., D. J. Ode, J. A. Pearson, and G. M. Vandel III
1985. "Rare animals and plants of South Dakota." *Prairie Naturalist.* 17(3):143-165.

Ingelfinger, F.M.

2001. The Effects of Natural Gas Development on Sagebrush Steppe Passerines in Sublette County, Wyoming. M.S. Thesis, Department of Zoology and Physiology, University of Wyoming, Laramie, WY.

Ingles, L.G.

1965. Mammals of the Pacific States. Stanford, CA. Stanford University Press.

Jarrett, A. R.

1995. Water management. Kendall, Iowa. Hunt Publishing Company.

Jennings, W. F.

1989. Final report. Species studied: *Eustoma grandiflorum, Spiranthes diluvialis, Malaxis brachypoda, Hypoxis hirsuta, Physaria bellii, Aletes humilis.* Unpublished report prepared for the Nature Conservancy under the Colorado Natural History Small Grants Program. The Nature Conservancy, Boulder, CO.

Jennings, W. F.

1990. Final report. Species studied: Spiranthes diluvialis, Sisyrinchium pallidum. Unpublished report prepared for The Nature Conservancy under the Colorado Natural History Small Grants Program. The Nature Conservancy, Boulder, Colorado. 29 pp.

Jones, A.H., G.B. Bell, and R.A. Schraufnagel

1992. "A review of the physical and mechanical properties of coal with implications for coalbed methane well completion and production." In: Coal Bed Methane. S.A. Holditch et al., eds. Soc. of Petrol Eng. Reprint Series No. 35.

Keister, G. P., and M. J. Willis.

1986. Habitat selection and success of sage grouse hens while nesting and brooding. Oregon Department of Fish and Wildlife, Progress Report W-87-R-2, Subproject 285, Portland, OR.

Kemner, M. C. and B. Lowe

2002. Sage grouse winter habitat—why we need multiple years of data collection. Presented at the annual meeting of the Idaho Chapter of The Wildlife Society. March 18–19, 2002. Idaho Falls, ID.

Knight, R.L. and D.N. Cole

1991. Effects of recreational activity on wildlife in wildlands. Transactions of the North American Wildlife and Natural Resources Conference.

Koford, C. B.

1958. "Prairie dogs, whitefaces, and blue grama." *Wild. Monogr.* 3:1-78.

Kohn, S. C.

1976. Sharp-tailed grouse nesting and brooding habitat in southwest North Dakota. M.S. Thesis, South Dakota State University, Brookings, SD.

Langhus, B.

2001. Personal communication between Dr. B.G. Langhus/ALL Consulting with Tim Burkhardt/CH2M HILL. May, 2001.

Lahti, T.

2001. Personal communication between T. Lahti/BLM, Cheyenne, WY, and C. Blair/CH2M HILL, Boise, ID. July 23, 2001.

Leythenhaeuser, D., and Welte, D

1969. Relation between distribution of heavy *n*-paraffins and coalification in carboniferous coals of the SAAR district, Germany. *In* P. Schrenk and I. Havenaar (eds.), *Advances in Organic Geochemistry,* 1968. NYC, Pergamon Press, pp. 429-442.

Little Coyote, J.

2001. Comprehensive Economic Development Strategy. CEDS document. Prepared by the Economic Development Administration for the Northern Cheyenne Tribe, Lame Deer, MT.

Luckenbach, R.A.

1975. What the ORVs are doing to the desert. Fremontia s(4):3-11.

Luckenbach, R.A.

1978. An analysis of off-road vehicle use on desert avifaunas. Transactions of the North American Wildlife and Natural Resources Conference. Wildlife Management Institute, Washington, DC, 43:157-162.

Lyman, R. M. and Volkmer, John E.
2001. Pyrophoricity (spontaneous combustion) of Powder River Basin coals—considerations for coalbed methane development, Coal Report CR 01-1, Laramie, Wyoming, March 2001: Wyoming State Geological Survey.

Lyon, A. G.
2000. The potential effects of natural gas development on sage grouse (*Centrocercus urophasianus*) near Pinedale, Wyoming. Thesis, University of Wyoming, Laramie.

Lyon, L.J.
1979. "Habitat effectiveness for elk as influenced by roads and cover." *Journal of Forestry*. 77:658-60.

Lyon, L.J.
1983. "Road density models describing habitat effectiveness for elk." *Journal of Forestry*. 81:592-595, 613.

Mader, H.J.
1984. "Animal habitat isolation by roads and agricultural fields." *Biological Conservation*. 29:81-96.

Madison, C.
2001. Personal Communication between ALL Consulting and Clark Madison/BIA Realty Office, Billings, MT. April 25, 2001.

Madsen, J.
1985. "Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark." *Biological Conservation*. 33:53-64.

Martin, N. S.
1970. "Sagebrush control related to habitat and sage grouse occurrence." *Journal of Wildlife Management.* 34(2):313-320.

Mattson, D. J., and D. G. Despain
1985. Grizzly bear habitat component mapping handbook for the Yellowstone ecosystem. Interagency Grizzly Bear Study Team: National Park Service and U.S. Forest Service, May 1985.

MBMG
See Montana Bureau of Mines and Geology.

MBOGC
See Montana Board of Oil and Gas Conservation.

McLellan, M.W., Biewick, L.R.H., Molnia, and Pierce, F.W.
1990. Cross sections showing the reconstructed stratigraphic framework of Paleocene rocks and coalbeds in the northern and central Powder River Basin, Montana and Wyoming. USGS Misc. Invest., Map I-1959-A.

McCracken, J. G. and Daniel W. Uresk
1984. "Big game habitat use in southeastern Montana." *The Prairie Naturalist.* 16(3):135-139.

MDEQ
See Montana Department of Environmental Quality.

MDNRC
See Montana Department of Natural Resources and Conservation.

Meehan, W.R., ed.
1991. In *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats.* American Fisheries Society Special Publication 19.

Memphis State University
1971. Effects of noise on wildlife and other animals. Washington D.C. U.S. Government Printing Office. NTID300.5.

Merriam G., M. Kozakiewicz, E. Tsuchiya, and K. Hawley
1989. "Barriers as boundaries for metapopulations and demes of Peromyscus leucopus in farm landscapes." *Landscape Ecology.* 2:227-236.

Meyer, J.
2000. Testimony before Wyoming Select Water Committee, Gillette, WY. November, 2000.

Miller, M. et al.
1977. Compilation of Hydrogeological data for Southeastern MT. MBMG Open File Report Hy77-1.

Miller, W.R.
1981. Water resources of the Southern Powder River area, Southeastern Montana, MBMG, Memoir 47.

Milodrgovich, S.
2001. Montana Power Company. Personal Communication with Larry Ran, BLM.

Montana Board of Oil and Gas Conservation
1989. *Oil and gas drilling and production in Montana: Final programmatic environmental impact statement.* Prepared for the Board of Oil and Gas Conservation. Pursuant to Senate Bill 184, with assistance from the Office of the Governor, the Department of Health and Environmental Sciences, the Department of Fish, Wildlife and Parks, the Department of State Lands, and the Department of Natural Resources and Conservation.

Montana Board of Oil and Gas Conservation
1999. Montana Board of Oil and Gas Annual Review, Oil and Gas Conservation Division, Department of Natural Resources and Conservation.

Montana Board of Oil and Gas Conservation
2000. *Activity review—annual review for the year 1999*, Montana Bureau of Oil and Gas Conservation.

Montana Board of Oil and Gas Conservation
2001a. Montana Bureau Of Oil and Gas Database, April 2001.

Montana Board of Oil and Gas Conservation
2001b. CX Ranch second quarter production records, June 2001.

Montana Board of Oil and Gas Conservation.
2002. Montana Board of Oil and Gas Conservation database, June 2002.

Montana Board of Oil and Gas Conservation and USDI Bureau of Land Management
1987. Cooperative Agreement between U.S. Department of the Interior, Bureau of Land Management, Montana State Office, and the State of Montana, Board of Oil and Gas Conservation concerning Oil and Gas Well Spacing/Well Location Jurisdiction, November 19, 1987.

Montana Bureau of Mines & Geology
1982. Occurrence and characteristics of groundwater in Montana, 1982. Montana Bureau of Mines and Geology. 99(1).

Montana Bureau of Mines & Geology
2001. Montana Bureau of Mines and Geology, groundwater Information Center database, http://mbmggwic.mtech.edu/ March.

Montana Bureau of Mines & Geology
2002. Potential Ground-water Drawdown and Recovery from Coalbed Methane Development in the Powder River Basin, Montana, Open File Report MBMG 485, John Wheaton & John Metesh.

Montana Department of Agriculture
2000. Montana agricultural statistics 2000; 1998-1999 county estimates. ISSN: 1095-7278, Volume XXXVII.

Montana Department of Commerce
2001. Montana Department of Commerce, Census and Economic Information Center. Projections by NPA Data Services, Inc. http://ceic.commerce.state.mt.us. <April 17, 2001>.

Montana Department of Commerce, Billings
2001. Personal communication between Glenda Craft/Montana Department of Commerce, Billings, and Tim Burkhardt/CH2M HILL. April 24, 2001.

Montana Department of Environmental Quality
1999. Air Quality Monitoring Data. http://www.deq.state.mt.us/ppa/mdm/air/nwrev/nw_intro.asp. <July 9, 2001>.

Montana Department of Environmental Quality
2001a. Nondegradation of water quality (rules), Administrative Rules of Montana 17.30.501-518.

Montana Department of Environmental Quality
2001b. State of Montana Air Quality Nonattainment Area Maps. http://www.deq.state.mt.us/ppa/rpp/air_nonattainment.asp. <November 8, 2001>.

Montana Department of Environmental Quality
2001c. Water Quality White Paper, Powder River Basin Water Quality Criteria, October, 2001.

Montana Department of Labor & Industry, Research & Analysis Bureau, Local Area Unemployment Statistics
2001a. Information for 1990 and 2000. http://rad.dli.state.mt.us/employ/aa901f.htm. <April 11, 2001>.

Montana Department of Labor and Industry
2001b. Email from Phil Brooks, Chief Economist, to Tim Burkhardt, CH2M HILL, September 20, 2001.

Montana Department of Natural Resources and Conservation, Minerals Management Bureau
2001. http://www.dnrc.state.mt.us/trust/mmb.htm. <April 25, 2001>.

Montana Department of Natural Resources and Conservation, Trust Land Management Division, Minerals Management.
2000. Montana Department of Natural Resources and Conservation. Trust Land Management Division, Minerals Management. www.dnrc.state.mt.us/trust/mmb.htm. <April 2001>

Montana Department of Revenue
2000. Biennial report of the Montana Department of Revenue, July 1, 1998 to June 30, 2000. Prepared by Tax Policy and Research. Helena, MT.

Montana Department of Revenue
2001. Guide to taxes administered by the Montana Department of Revenue. Compiled by Tax Policy and Research, Helena, MT.

Montana Gap Analysis Project
1998. The Montana gap analysis project final report. Wildlife Spatial Analysis Lab. Montana Cooperative Wildlife Research Unit at the University of Montana, Missoula, MT.

Montana State Library NRIS (Natural Resources Information System)
2001. Guidebook to Montana's plant species of special concern. http://orion2.nris.state.mt.us/mtnhp/plants. <April 9, 2001>.

Montana State Office Instruction Memorandum (MSO IM)
2000. See MSO IM No. 2000-053, June 1, 2000 for No Surface Occupancy Stipulations.

Montana-Wyoming Tribal Council
2001. Montana-Wyoming Tribal Council Web Page. http://www.tlc.wtp.net/Northern.htm. <May 2001>.

Mongomery, S.L., D.E. Tabet, and C.E. Barker.
2001. Upper Cretaceous Ferron Sandstone: major coalbed methane play in central Utah. A.A.P.G. Bull v. 85, pp. 199-219.

Mount, D.R., D.D. Gulley, J.R. Hockett, T.D. Garrison, and J. M. Evans
1997. "Statistical models to predict the toxicity of major ions to Ceriodaphnia dubia, Daphnia magna and Pimiphales promelas (fathead minnows)." *Environmental Toxicology and Chemistry*. 16 (10): 2009-2019.

MT-GAP
See Montana Gap Analysis Project.

Murphy, M.L. and W.R. Meehan
1991. "Stream ecosystems." In *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats.* William R. Meehan, ed., U.S. Department of Agriculture, Forest Service. American Fisheries Society Special Publication 19. Bethesda, MD.

Nelson, C. R.
2000. "Coalbed methane potential of the U.S. Rocky Mountain Region." *GasTips*. Fall 200. 6(3)4-12.

Nelson, R.L., M.L. McHenry, and W.S. Platts
1991. "Mining." In *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats.* William R. Meehan, ed., U.S. Department of Agriculture, Forest Service. American Fisheries Society Special Publication 19. Bethesda, MD.

Newcombe, C.P. and J.O.T. Jensen
1996. "Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk." *North American Journal of Fisheries Management.* 16:693-727.

Noble, R.A., R.N. Bergantino, T.W. Patton, B. Sholes, F. Daniel, and J. Schofield
1982. Occurrence and characteristics of groundwater in Montana, MBMG 99.

Norris, L.A., H.W. Lorz, and S.V. Gregory
1991. "Forest chemicals." In *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats.* William R. Meehan, ed., U.S. Department of Agriculture, Forest Service. American Fisheries Society Special Publication 19. Bethesda, MD.

Northern Cheyenne Tribe
2001. Draft Application to EPA for Water Quality Standards Program , Northern Cheyenne Reservation, Lame Deer, Montana.

Northern Cheyenne Tribe
2002. The Northern Cheyenne Tribe and Its Reservation. A report to the U.S. Bureau of Land Management and the State of Montana Dept. of Natural Resources and Conservation. April 2002.

Northern Cheyenne Tribe–State of Montana
1991. Water Rights Compact, State of Montana, Northern Cheyenne Tribe, United States of America, 85-20-301, MCA. Northern Cheyenne-Montana Compact , en. sec. 1, ch. 812, l. 1991.

Nussbaum, R. A., E. D. Brodie, Jr., and R. M. Storm
1983. *Amphibians and reptiles of the Pacific Northwest.* University of Idaho Press. Moscow, ID.

Office of Surface Mining Reclamation and Enforcement
1998. Annual evaluation summary report for regulatory and abandoned mine land programs administered by the State of Montana. Evaluation Year 1998.

Oxley, D.J. and M.B. Fenton
1974. "The effects of roads on populations of small mammals." *Journal of Applied Ecology.* 11:51-59.

Padden, L.
2001. Personal communication between L. Padden/BLM Billings Field Office with David Epperly/ALL Consulting. April 23, 2001.

Perry, E.S.
1962. Montana in the geologic past. Montana Bureau of Mines and Geology. Bulletin Number 26.

Perry, C. and R. Overly
1976. Impact of roads on big game distribution in portions of the Blue Mountains of Washington. In *Hieb SR, ed. Proc. Elk-Logging-Roads Symposium*. Univ. of Idaho. For. Wildl. and Range Exp. Sta., Moscow, Idaho. p. 62-8.

Perry, E.S.
1962. Montana in the Geologic Past, MBMG Bulletin 26, March 1962.

Peterson L. and S. Deaver
2002. An Ethnographic Overview of Southeast Montana, February 2001. Prepared for the BLM State Office, Billings, MT.

Petroleum Information Corporation
2001. Historical Well Data Base for Montana.

Pitchford, Marc L., and William C. Malm
1994. Development and Applications of a Standard Visual Index. *Atmospheric Environment* 28(5):1,049-54.

Ports, M. A., and S. B. George
1990. S orex preblei in the northern Great Basin. *Great Bas. Nat.* 50:93-95.

Posewitz, J.
1994. *Beyond fair chase: the ethic and tradition of hunting.* Helena, MT.: Falcon Publishing Co., Inc.

PTTC
2000. Coal bed methane strategraphic traps in the ferron coals of east-central Utah, PTTC Rocky Mountain Newsletter, September.

Ranney, H.J.
2001. Discussion of Bicarbonate Issues Relative to CBM Development, Letter to MDEQ, November 14, 2001.

Reading, R. P., J. J. Grensten, and T. W. Clark
1989. "Attributes of black-tailed prairie dog colonies in north central Montana, with management recommendation for the conservation of biodiversity." *In*: The Prairie Dog Ecosystem: Managing for Biological Diversity. Tim W. Clark, Dan K. Hinckley and Terrell Rich, eds. Montana BLM Wildlife Technical Bulletin No. 2. Billings, MT.

Reed, G.
2002. Personal communication with Mr. George Reed of the Crow Tribe Cultural Department, September 10, 2002.

Regele, S. and J. Stark
2000. "Coal-bed methane gas development in Montana, some biological issues." Symposium proceedings, September 1, 2000: Interactive forum on Surface Mining Reclamation Approaches to Bond Release. Sponsored by USDI Office of Surface Mining, Denver, CO; the MDEQ, Helena, MT; and Montana Bureau of Mines and Geology, Butte, MT.

Reichel, J. D., D. L. Genter, and E. Atkinson
1992. Sensitive animal species in the Elkhorn and Big Belt Mountains of the Helena National Forest. Montana Natural Heritage Program. Helena, MT.

Reichel, J. D., and D. Flath
1995. "Identification of Montana's amphibians and reptiles." *Montana Outdoors* 26(3):15-34.

Reid, L.M. and T. Dunne
1984. Sediment production from forest road surfaces. *Water Resources Research.* 20:1753-1761.

Rice, D.D.
1997. Coalbed methane—an untapped energy resource and an environmental concern: U.S. Geological Fact Sheet FS-019-97. http://energy.usgs.gov/factsheets/coalbed/coalmeth.html.

Rice, C. A., M. S. Ellis, and J. H. Bullock
2000. Water co-produced with coal bed methane. USGS Open File report 00-372.

Roberts, Albert E.
1966. Geology and Coal Resources of the Livingston Coal Field, Gallatin and Park Counties, Montana. U.S. Geological Survey Professional Paper 526-A.

Roberts, S.B., G.L. Gunther, T.T. Taber, A.M. Ochs, D. Blake, M.S. Ellis, G.D. Stricker, E.M. Wilde, J.H. Schuenemeyer, and H.C. Power.
1999a. Decker Coalfield, Powder River Basin, Montana: geology, coal quality, and coal resources, in USGS Prof. Paper 1625-A.

Roberts, S.B., E.M. Wilde, G.S. Rossi, D. Blake, M.S. Ellis, G.D. Stricker, A.M. Ochs, G.L. Gunther, J.H. Schuenmeyer, and H.C. Power.
1999b. Ashland Coalfield, Powder River Basin, Montana: geology, coal quality, and coal resources, in USGS Prof. Paper 1625-A.

Roedel, M. D.
1999. Montana animal species of special concern [Unpublished list.] Montana Natural Heritage Program, Helena, MT.

Rost, G.R. and J.A. Bailey
1979. "Distribution of mule deer and elk in relation to roads." *Journal of Wildlife Management*. 43:634-641.

Saab, V.A., C.E. Bock, T.D. Rich, D.S. Dobkin
1995. "Livestock grazing effects in western North America." In: Martian, Thomas E.; Finch, Deborah M., eds. *Ecology and management of neotropical migratory birds*. New York: Oxford University Press: 311-353.

Sage Grouse Winter Habitat—Why We Need Multiple Years of Data Collection
2002. Presented at the Idaho Chapter, The Wildlife Society Meeting, March 2002. Idaho Falls, Idaho.

Savage, D. E.
1969. Relation of sage grouse to upland meadows in Nevada. Nevada Fish and Game Commission, Job Completion Report, Project W-39-R-9, Job 12, Reno, NV.

Schneider, T. J.
2001. Coal Bed Methane Produced Water Re-Injection, NPRC White Paper, May 16, 2001.

Shafroth, P.B., J.M. Friedman, and L.S. Ischinger
"Effects of salinity on establishment of *Populus fremontii* (cottonwood) and *Tamarix ramosissima* (saltcedar) in southwestern United States." *Great Basin Naturalist.* 55(1): 58-65.

Schafer, Jerry
2001. Natural Resource Conservation Service (NRCS), Bozeman via personal communication with Tom Pick, NRCS, Bozeman.

Sheley, R.
2001. Basics of Leafy Spurge. http://www.weeds.montana.edu/range/spurge.htm. MSU Weed Sciences. October 2001.

Sheviak, C. J.
1984. "*Spiranthes diluvialis* (*Orchidacae*), a new species from the western United States." *Brittonia.* 36:8-14.

Slagle, S.E., B.D. Lewis, and R.W. Lee
1985. Groundwater resources and potential hydrologic effects of surface coal mining in the northern Powder River Basin, southeastern Montana. U.S. Geological Surve Water Supply Paper 2239.

Solley, W. B., Robert R. Pierce, and Howard A. Perlman
1995. Estimated use of water in the United States in 1995. U.S. Geological Survey Circular 1200.

Stoddart, L. A., A. D. Smith, and T. Box
1975. *Range Management.* Third edition. McGraw-Hill Book Co., Inc. New York.

Stone, J. L.
1971. Winter movements and distribution of moose in upper Rock Creek drainage, Granite County, Montana. M.S. thesis. University of Montana, Missoula, MT.

Stricker, G.D.
1999. Bull Mountain Basin, Montana *in* 1999 Resource Assessment of Selected Tertiary Coal Beds and Zones in the Northern Rocky Mountains and Great Plains Region, USGS Open File Report, 1625-A.

Supreme Court of the United States
Montana et al. v. Crow Tribe of Indians et al., certiorari to the United States Court of Appeals for the Ninth Circuit, No. 96—1829. Argued February 24, 1998–Decided May 18, 1998.

Swihart, R.K. and N.A. Slade
1984. "Road crossing in *Sigmodon hispidus* and *Microtus ochrogaster*." *Journal of Mammalogy.* 65:357-360.

Thomas, C.E, C.F. Mahoney, and G.W. Winter
1987. "Water-injection maintenance and waterflood processes." In: *Petroleum Engineering Handbook.* H.B. Bradley, ed.. Soc. of Petrol Eng. Richardson, TX.

Trent, J.
1991. Sociology Survey of 100 Respondents in the Planning Area. U.S. Department of the Interior, Bureau of Land Management, Montana State Office, Billings, MT.

Tribby, D.
2001. Personal communication between D. Tribby/BLM Miles City Field Office with David Epperly/ALL Consulting. April 12, 2001.

Trombulak, S.C. and C.A. Frissell
2000. "Review of ecological effects of roads on terrestrial and aquatic communities." *Conservation Biology.* 14:18-30.

Tudor, M.S.
1975. Geologic exploration and development of coal in the Sarpy Creek area, Big Horn County, Montana, in J. Doroshenko, W.R. Miller, E.E. Thompson, Jr., J.H. and Rawlins, eds., Energy Resources of Montana: Montana Geological Society 22nd Annual Publication, pp. 159-164.

Tyler, J. D.
1968. Distribution and vertebrate associations of the black-tailed prairie dog in Oklahoma. PhD. Thesis, University of Oklahoma, Norman, OK.

Uresk, D.W. and J.C. Sharps.
1986. Denning habitat and diet of swift fox in western South Dakota. Great Basin Naturalist 46:249-253.

U.S. Bureau of Economic Analysis.
2001. Regional Economic Information System. http://www.bea.doc.gov/bea/regional/bearfacts/bf10/index.htm. Accessed March 21, 2001.

U.S. Bureau of Indian Affairs
1994. Land Titles and Records Office. U.S. Department of the Interior, Bureau of Indian Affairs, Rocky Mountain Regional Office.

U.S. Bureau of Indian Affairs
1999. Indian Labor Force Report, 1999. U.S. Department of the Interior, Bureau of Indian Affairs Office of Tribal Services.

U.S. Bureau of Reclamation
1994. Indian Trust Asset Policy and NEPA Implementing Procedures, Questions and Answers about the Policy and Procedures. U.S. Department of the Interior, Bureau of Reclamation. August 31, 1994.

U.S. Census Bureau
1990. Household and housing unit estimates. http://www.census.gov/population/www/estimates/housing.html. <March 21, 2001>.

U.S. Census Bureau
2001a. Census 2000 redistricting data (Public Law 94-171) summary file, matrices PL1 and PL2. http://www.census.gov. <March 21, 2001>.

U.S. Census Bureau Small Area Income and Poverty Estimates Program
2001b. Small Area Income and Poverty Estimates Program. U.S. Census Bureau website at http://ceic.commerce.state.mt.us/Demog/estimate/poverty/97allages.htm, accessed 2001.

U.S. Department of Agriculture
1991. Record of Decision, Noxious Weed Management Amendment to Lolo National Forest Plan. U.S. Forest Service. Accessed via USDI Bureau of Land Management Weed Plan Web Site. http://www.blm.gov/nhp/main/WP7weedplan.html <July 6, 2001>

U.S. Department of Agriculture and U.S. Department of the Interior
2000. Source habitats for terrestrial vertebrates of focus in the interior Columbia Basin: broad-scale trends and management implications. Vol. 1-Overview. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station and U.S. Department of the Interior, Bureau of Land Management. General Technical Report PNW-GTR-485.

U.S. Department of Agriculture Forest Service
2000. Screening Methodology for Calculating ANC Change to High Elevation Lakes. Published by the USDA-Forest Service, Rocky Mountain Region. Lakewood, CO.

U.S. Department of Agriculture Natural Resources Conservation Service
1996 (1998 update). The state soils geographic database (STATSGO) (for Montana). U.S. Department of Agriculture, Natural Resource Conservation Service. http://www.ftw.nrcs.usda.gov/stat_data.html <March 2001>.

U.S. Department of Agriculture Natural Resources Conservation Service (formerly Soil Conservation Service)
1972. Soil Survey of Yellowstone County, Montana. Soil Conservation Service.

U.S. Department of Commerce
1996. *American Indian Reservations and Trust Areas.* Accessed via Senator Max Baucus' web page. http://www.baucus.senate.gov/tribes.html. <November 12, 2001>.

U.S. Department of Commerce, BEA
2001. U.S. Department of Commerce, Bureau of Economic Analysis, 2001. http://ceic.commerce.state.mt.us/Economic/BEA/CountyReis/index.htm. <March 21, 2001; April 25, 2001; April 30, 2001>.

U.S. Department of the Interior
2000. Coalbed methane: potential and concerns. Fact Sheet FS-123-00.

U.S. Department of the Interior and U.S. Department of Agriculture (USDI and USDA)
2001. Off-highway vehicle environmental impact statement and proposed plan amendment for Montana, North Dakota and portions of South Dakota. U.S. Department of the Interior, Bureau of Land Management, Montana State Office and U.S. Department of Agriculture, Forest Service, Northern Region.

U.S. Department of Interior and U.S. Department of Agriculture
1989. Surface Operating Standards for Oil and Gas Exploration and Development, USDOI BLM and USDA Forest Service, Third Edition, January 1989

USDI Bureau of Land Management
1983. *Final environmental impact statement, resources management plan, Billings resource area.* U.S. Department of the Interior, Bureau of Land Management. November 1983. BLM-MT-ES-84-002-4410.

USDI Bureau of Land Management
1984a. Record of Decision for the Billings Resource Management Plan, Final Environmental Impact Statement, September 1984, United States Department of Interior, Bureau of Land Management, Miles City District Office, September 1984.

USDI Bureau of Land Management
1984b. Powder River Resource Area, Resource Management Plan, Miles City District, Final Environmental Impact Statement, December 1984, United States Department of Interior, Bureau of Land Management, Miles City District Office, BLM-MT-ES-85-0014410.

USDI Bureau of Land Management
1985. Record of Decision for the Powder River Resource Area, Resource Management Plan, Final Environmental Impact Statement, March 1985, United States Department of Interior, Bureau of Land Management, Miles City District Office, September 1985.

USDI Bureau of Land Management
1989. *Powder River I regional draft EIS, economic, social, and cultural supplement.* U.S. Department of the Interior, Bureau of Land Management, Miles City District Office.

USDI Bureau of Land Management
1992. *Final Oil and Gas RMP/EIS Amendment for the Billings, Powder River and South Dakota Resource Areas.* U.S. Department of the Interior, Bureau of Land Management, Miles City District.

USDI Bureau of Land Management
1994. *Record of Decision: Powder River, Billings, and South Dakota Oil and Gas RMP/EIS Amendment.* Miles City District, MT.

USDI Bureau of Land Management
1995. *Big Dry Resource Management Plan/ Environmental Impact Statement for the Big Dry Resource Area of the Miles City District*. Final. U.S. Department of the Interior, Bureau of Land Management.

USDI Bureau of Land Management
1996. Partners against weeds: an action plan for the Bureau of Land Management. BLM/MT/ST-96/003+1020.

USDI Bureau of Land Management
1998. Document H3160-2, Drainage Protection Guidelines Instruction Memorandum, DOI, BLM 3160-2 Drainage Protection Manual, State and Field Office Fluid Minerals staff, Denver Service Center, National Training Center.

USDI Bureau of Land Management
1999a. ACEC Record of Decision. March 1999.

USDI Bureau of Land Management
1999b. *Wyodak coalbed methane project final EIS.* U.S. Department of the Interior, Bureau of Land Management, Buffalo Field Office.

USDI Bureau of Land Management
1999c. Seeding policy. Instruction Memorandum No. MT-020-2000-001. U.S. Department of the Interior, U.S. Bureau of Land Management, Miles City District Office. Miles City, MT.

USDI Bureau of Land Management
1999d. Final Environmental Impact Statement - Continental Divide/Wamsutter II Natural Gas Project, Sweetwater and Carbon Counties. Rawlins and Rock Springs Field Offices. Rawlins and Rock Springs, WY.

USDI Bureau of Land Management
2000a. Guidelines for Identifying Cultural Resources H-81-10, BLM Montana, Draft April 2000.

USDI Bureau of Land Management
2000b. WYODAK Drainage Area EA, December.

USDI Bureau of Land Management.
2000c. *Oil and Gas Development on the Southern UTE Indian Reservation. Environmental Impact Statement. BLM, Durango, CO.*

USDI Bureau of Land Management
2001a. *Reasonable foreseeable development scenario for oil and gas development in the Buffalo field office area, Campbell, Johnson, and Sheridan counties, Wyoming*. Wyoming State Office, Reservoir Management Group.

USDI Bureau of Land Management
2001b. *Record of decision: Wyodak drainage coalbed methane environmental assessment.*

USDI Bureau of Land Management
2002a. Draft Environmental Impact Statement and Draft Planning Amendment for the Powder River Basin Oil and Gas Project. Buffalo Field Office. Buffalo, WY.

USDI Bureau of Land Management
2002b. Washington Office, Policy on Conflicts Between Coal Bed Methane (CBM) and Coal Development, February 22, 2002.

USDI Bureau of Land Management
2002c. Washington Office, Policy on Conflicts Between Coal Bed methane (CBM) and Coal development. Instruction Memorandum WO-IM-2000-81.

USDI Fish and Wildlife Service
1978. Terrestrial habitat evaluation criteria handbook Ecoregion M3113, South Rocky Mountains. U.S. Department of the Interior, Fish and Wildlife Service.

USDI Fish and Wildlife Service
1980. Rosebud Creek Study, Northern Cheyenne Indian Reservation.

USDI Fish and Wildlife Service
1986. Whooping crane recovery plan. U.S. Fish and Wildlife Service, Albuquerque, NM.

USDI Fish and Wildlife Service
1988. Black-footed ferret recovery plan. Denver, CO. 154 pp.

USDI Fish and Wildlife Service
1993. Final recovery plan for the pallid sturgeon (*Scaphirhynchus albus*). Denver, CO.

USDI Fish and Wildlife Service
1994a. Final rule: Endangered and threatened wildlife and plants; establishment of a nonessential experimental population of gray wolves in central Idaho and southwestern Montana. RIN 1018-AC86.

USDI Fish and Wildlife Service
1994b. Notice of 90-day finding on the petition to list the sturgeon chub and sicklefin chub as endangered.

USDI Fish and Wildlife Service
1994c. Notice of 12-month petition finding: Endangered and threatened wildlife and plants; finding on a petition to list the fluvial population of the arctic grayling as endangered.

USDI Fish and Wildlife Service
1996. Ute ladies'-tresses (*Spiranthes diluvialis*) agency review draft recovery plan, 1995. Prepared by the Ute ladies'-tresses recovery team for Region 6, U.S. Fish and Wildlife Service, Denver, CO.

USDI Fish and Wildlife Service

2001. Letter from Mr. R. Mark Wilson, Field Supervisor, Montana field Office, U.S. Fish and Wildlife Service, to Mr. Larry Rau, Bureau of Land Management, Montana City Field Office, regarding impacts of the proposed action on threatened, endangered, and proposed species. April 17, 2001.

USDI Fish and Wildlife Service

2002. Letter from Mr. R. Mark Wilson, Field Supervisor, MTFO, USFWS, to BLM, Miles City Field Office, regarding biological and conference opinions on impacts of the proposed action on threatened and endangered species. September 1, 2002.

USDI Minerals Management Service

2001. USDI website at http://www.mrm.mms.gov/Stats/statsrm.htm, accessed 2001.

USDL

See U.S. Department of Labor.

U.S. Department of Labor

1999. U.S. Department of Labor Website www.dol.gov.

U.S. District Court

2000. See September 21, 2000 order in Friends of the Wild Swan, et al., v. U.S. Environmental Protection Agency, et al., CV 97-35-M-DWM, U.S. District Court for the District of Montana, Missoula Division.

U.S. Environmental Protection Agency

1997a. National Air Toxics Information Clearinghouse (NATICH) Database. Office of Air Quality Planning and Standards. Research Triangle Park, NC.

U.S. Environmental Protection Agency

1997b. Integrated Risk Information System (IRIS) Database. Office of Air Quality Planning and Standards. Research Triangle Park, NC.

U.S. Environmental Protection Agency

2002. Letter from Robert E. Roberts, EPA Regional Administrator, "EPA's Review of the statewide Draft Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans, (CEQ #020060).

U.S. Geological Survey

Coal Fields of the Conterminous United States, Open File Report 96-92.

U.S. Geological Survey

1963. *Mineral and Water Resources of Montana: Report of the United States Geological Survey.* In collaboration with Montana Bureau of Mines and Geology. Prepared at the request of Senator Lee Metcalf of Montana of the Committee on Interior and Insular Affairs, United States Senate. P. 46.

U.S. Geological Survey

1995. Estimated Use of Water in the United States in 1995, USGS Circular 1200, 1996.

U.S. Geological Survey

1997. Estimated Use of Water in the United States in 1995, USGS Circular 1200, 1996.

U.S. Geological Survey

1998. Fort Union Coal Assessment Team. U.S. Geological Survey Professional Paper 1625-A, Resource Assessment of Selected Tertiary Coal Beds and Zones in the Northern Rocky Mountains and Great Plains Region.

U.S. Geological Survey

1999. Fort Union Coal Assessment Team. U.S. Geological Survey Professional paper 1625-A, Resource Assessment of Selected Tertiary Coal Beds and Zones in the Northern Rocky Mountains and Great Plains Region.

U.S. Geological Survey

2000. Coal bed methane: potential and concerns, USGS Fact Sheet, FS-123-00, October.

U.S. Geological Survey
2001. USGS Water Resources Database. http://waterdata.usgs.gov/mt/nwis/monthly?search_criteria=huc_cd&submitted_form=introduction <April 2001>.

USGS
See U.S. Geological Survey.

U.S. Supreme Court
1998. Syllabus Prepared by Reporter of Decisions No. 96-1829 *Montana et al. v. Crow Tribe of Indians et al.* Certiorari to the United States Court of Appeals for Ninth Circuit.

Van der Zande, A. N., W. J. ter Keurs, and W. J. Van der Weijden
1980. The impact of roads on the densities of four bird species in an open field habitat—evidence of a long distance effect. *Biological Conservation* 18:299-321.

Van Dyke, F.G., R.H. Brocke, and H.G. Shaw
1986. "Use of road track counts as indices of mountain lion presence." *Journal of Wildlife Management*. 50:102-109.

Van Voast, W. and Thale, P.
2001. Anderson and Knobloch Coal Horizons and Potential for Methane Development, Powder River Basin, MBMG Map 60, 2001.

Vestjens, W.J.M
1973. "Wildlife mortality on a road in New South Wales." *Emu*. 73:107-12.

Wakkinen, W. L., K. P. Reese, and J. W. Connelly.
1992. Sage grouse nest locations in relation to leks. *Journal of Wildlife Management*. 56:381-383.

Wallestad, R., and D. B. Pyrah
1974. "Movements and nesting requirements of sage grouse hens in Central Montana." *Journal of Wildlife Management*. 38(4):630-633.

Wallestad, R., and P. Schladweiler
1975. "Breeding season movements and habitat use of male sage grouse in Central Montana." *Journal of Wildlife Management*. 38(4):634-637.

Wallwork, S. S. and Maxine Johnson
1986. Natural resource development in Montana. Bureau of Business and Economic Research. University of Montana, Missoula, MT.

Ward, A.L., J.J. Cupal, A.L. Lea, C.A. Oakley, and R.W. Weeks
1973. "Elk behavior in relation to cattle grazing, forest recreation, and traffic." *Trans. N. Amer. Wildl. Nat. Resour. Conf.* 38:327-37.

Weber, L. M. and B. H. Martin
1991. "Piping plovers nest on dry and nearly dry alkaline wetlands in the northern Great Plains 1988-1990." *Prairie Naturalist*. 23: 209.

Weinstein, M.
1978. Impact of Off-Road Vehicles on the Avifauna of Afton Canyon, California. Bureau of Land Management. Department of the Interior. Final Report #CA-060-CT7-2734.

Wentland, H. J.
1968. Summer range habits of the pronghorn antelope in central Montana with special reference to proposed sagebrush control study plots. M.S. thesis. Montana State University, Bozeman, MT.

Wheaton, J. and J. Metesh
2001. Potential groundwater impacts from coal-bed methane development in portions of Montana. MBMG Administrative Report to U.S. Bureau of Land Management.

Wheaton, J. and J. Metesh
2002. "Potential Groundwater Drawdown and Recovery from Coal Bed Methane Development in the Powder River Basin, Montana," MBMG Open-File Report 458, May 2002.

Wheaton, J. and W. Van Voast
1998. A quarter century of coal mining and hydrological research in southeastern Montana. National Meeting of the American Society for Surface Mining and Reclamation. St. Louis, MO. May 1998.

Williams, J. and P. Diebel
1996. "The economic value of prairie." F.B. Samson and F.L. Knopf, eds. *In:* Prairie conservation preserving North America's most endangered ecosystem. *Island Press.* Covelo, CA.

Williams, B.
2001. Personal communication between Mr. Williams/V.P., Redstone and Dr. Langhus/ALL-LLC. March 23, 2001.

Wisdom, M.J., R.S. Holthausen, B.C. Wales, C.D. Hargis, V.A. Saab, D.C. Lee, W.J. Hann, T.D. Rich, M.M. Rowland, W.J. Murphy, and M.R. Eames
2000. Source habitats for terrestrial vertebrates of focus in the interior Columbia basin: broad-scale trends and management implications. Volume 1—Overview. Gen. Tech. Rep. PNW-GTR-485. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 3 vol.

WOGCC
2001. Coal Bed Methane Production Statistics, WOGCC web site <<http://wogcc.state.wy.us/>>, November, 2001.

Wyoming Game and Fish Department.
n.d. Creating wetlands for wildlife with coal bed methane water. Sheridan, WY. Pamphlet.

Yarmoloy, C., M. Bayer, and V. Geist
1988. "Behavior responses and reproduction of mule deer, *Odocoileus herionus*, does following experimental harassment with an all-terrain vehicle." *Canadian Field-Naturalist*. 102:425-429.

Youmans, H. B., and J. E. Swenson
1982. Winter distribution of habitat use by mule deer and white-tailed deer in southeastern Montana. Appendix to Big Game Survey and Inventory (Deer) Region Seven, Progress Report W-130-R-13, Job 1-7. Montana Department of Fish, Wildlife and Parks.

Zelt, Ronald B., Greg Boughton, Kirk A. Miller, Jon P. Mason, and Laura M. Gianakos
1999. *Environmental setting of the Yellowstone River Basin, Montana, North Dakota, and Wyoming*. U.S. Geological Survey Water-Resources Investigations Report 98-4269.

Ziewitz, J. W., J. G. Sidle and J. J. Dinan
1992. "Habitat conservation for nesting least terns and piping plovers on the Platte River, Nebraska." *Prairie Naturalist.* 24:1-20.

ZurMuehlen, A.
2001. Coalbed methane development: economic and social impacts of proposed development in the Powder River Basin of Montana. Anderson ZurMuehlen and Co., PC, Certified Public Accountants and Business Consultants. Billings MT. June 1, 2001.

INDEX

A

access
Chapter 1: 13, 14, 17, 19, 20, 22
Chapter 2: 6, 10, 11, 12, 15, 16, 19, 31, 33, 34, 35, 37, 38
Chapter 3: 3, 7, 41, 47, 48, 57, 58, 60
Chapter 4: 5, 6, 7, 9, 18, 37, 90, 95, 96, 97, 98, 99, 100, 101, 102, 106, 107, 108, 109, 110, 111, 112, 113, 123, 135, 137, 138, 142, 146, 149, 151, 153, 154, 155, 156, 158, 160, 165, 167, 172, 175, 182, 184, 185, 187, 190, 191
Chapter 5: 10, 13, 30, 37, 40, 64, 65, 66, 69, 76, 88, 93, 103, 118

agriculture
Chapter 1: 8, 20, 21
Chapter 3: 27, 28, 29, 30, 31, 42, 43, 49, 50, 51, 82, 83, 84, 85, 93, 97, 106
Chapter 4: 14, 48, 49, 63, 95, 96, 99, 131, 193
Chapter 5: 11, 42, 45, 64, 72, 73, 74, 81, 85, 97

allotments
Chapter 3: 40, 42, 47, 50
Chapter 5: 8

amphibians
Chapter 2: 37
Chapter 3: 57, 73, 105
Chapter 4: 160, 164, 167, 168, 175, 177, 179, 182, 193
Chapter 5: 95, 107, 108

Areas of Critical Environmental Concern
Chapter 1: 19

Assiniboine
Chapter 3: 40, 42, 48, 51

B

barren lands
Chapter 2: 35
Chapter 3: 56, 97, 98
Chapter 4: 144, 150

Big Horn County
Chapter 1: 2
Chapter 2: 10
Chapter 3: 49, 50, 76, 77, 79, 81, 86, 87, 88, 93
Chapter 4: 113, 115, 116, 117
Chapter 5: 76, 88, 111

black-footed ferret
Chapter 3: 57, 72, 103, 106, 107, 108
Chapter 4: 169, 172, 175
Chapter 5: 2, 95, 101, 103, 105, 107, 108

Blaine County
  Chapter 3: 8, 20, 27, 32, 50, 74, 76, 77, 79, 81, 86, 87, 88, 94, 101, 104, 105, 106, 112
  Chapter 4: 10, 11
  Chapter 5: 101

bonding
  Chapter 1: 7
  Chapter 2: 3
  Chapter 5: 7, 32, 39, 40, 87, 109

C

Carbon County
  Chapter 3: 5, 73, 76, 77, 79, 81, 86, 88, 101, 103
  Chapter 4: 2
  Chapter 5: 33, 112

Carter County
  Chapter 3: 76, 77, 79, 81, 86, 87, 88

Crow Tribe
  Chapter 1: 1, 2, 5, 10, 11, 12
  Chapter 2: 2
  Chapter 3: 1, 5, 40, 41, 48, 49, 50, 51, 53, 54, 55, 56, 57, 79, 87
  Chapter 4: 37, 94, 123, 130, 132
  Chapter 5: 2, 3, 9, 31, 42, 84, 112, 123

Custer County
  Chapter 3: 76, 77, 79, 81, 86, 88, 106
  Chapter 5: 82

D

demographics
  Chapter 2: 34
  Chapter 3: 49, 58, 76, 79, 93
  Chapter 4: 98, 112, 115, 119, 124, 125, 127
  Chapter 5: 71, 80

E

easements
  Chapter 1: 13, 16
  Chapter 3: 75

education
  Chapter 1: 9, 10
  Chapter 3: 49, 59, 61
  Chapter 5: 101

employment
  Chapter 1: 11
  Chapter 2: 34
  Chapter 3: 49, 50, 59, 60, 82, 83, 84, 85
  Chapter 4: 90, 112, 113, 115, 116, 117, 119, 122, 123, 124, 125, 126, 127, 128
  Chapter 5: 6, 71, 72, 73, 74, 79

engineering
Chapter 1: 7, 14
Chapter 2: 3
Chapter 3: 53, 62, 68
Chapter 4: 14
Chapter 5: 14, 28, 55, 58, 111

environmental justice
Chapter 1: 21
Chapter 2: 24
Chapter 3: 76, 93
Chapter 4: 43, 128, 129, 130, 131, 132
Chapter 5: 32, 58, 59, 60, 61, 80, 83, 84, 121, 123

exchanges
Chapter 1: 16

F

ferruginous hawk
Chapter 3: 104
Chapter 4: 162

fire management
Chapter 4: 98

fisheries
Chapter 1: 22
Chapter 2: 9, 39
Chapter 3: 28, 57, 72, 108, 109, 110, 111, 112
Chapter 4: 12, 182, 183, 185, 188, 191, 193
Chapter 5: 45, 69, 72, 83, 97, 101, 109, 111, 122

Fort Belknap
Chapter 1: 2
Chapter 2: 2, 22, 23
Chapter 3: 40, 42, 48, 50, 77, 86, 87, 94, 106, 108
Chapter 4: 13, 23, 25, 28, 30, 35, 92, 169

Fort Belknap Indian Reservation
Chapter 1: 2
Chapter 2: 22, 23
Chapter 3: 42, 86, 108
Chapter 4: 13, 25, 28
Chapter 5: 8

G

Gallatin County
  Chapter 3: 27, 76, 77, 79, 81, 86, 88, 112, 113
  Chapter 4: 10, 11
  Chapter 5: 34, 39

General Permit
  Chapter 1: 6, 10

Golden Valley County
  Chapter 3: 74, 76, 77, 79, 81, 86, 88, 101

grasslands
  Chapter 1: 21
  Chapter 2: 35
  Chapter 3: 97, 102, 103, 105, 107
  Chapter 4: 144, 147, 150
  Chapter 5: 104

Gros Ventre Tribe
  Chapter 3: 40, 42, 48, 51

H

hazardous materials
  Chapter 1: 19
  Chapter 3: 96
  Chapter 4: 142, 143
  Chapter 5: 39, 88

hazardous wastes
  Chapter 2: 8, 35
  Chapter 3: 96
  Chapter 4: 142, 143
  Chapter 5: 33, 88

Hell Creek Area of Critical Environmental Concern
  Chapter 3: 10, 16, 32, 36, 37, 38, 54, 62, 64, 73

I

injection
  Chapter 1: 7, 12, 15, 18, 20
  Chapter 2: 3, 11, 12, 14, 19, 26, 34
  Chapter 3: 10, 68
  Chapter 4: 9, 44, 46, 51, 61, 62, 63, 64, 75, 77, 78, 80, 82, 83, 84, 90, 99, 104, 112, 119, 124, 127, 138, 140, 151, 191, 196
  Chapter 5: 7, 28, 36, 38, 39, 44, 45, 46, 49, 56, 59, 63

L

Leasing Stipulations
Chapter 2: 5, 16
Chapter 4: 7, 169, 170, 179, 183
Chapter 5: 69

Little Big Horn River
Chapter 2: 39
Chapter 3: 48
Chapter 4: 182

Little Powder River
Chapter 1: 12
Chapter 2: 26
Chapter 3: 30, 110, 111
Chapter 4: 50, 51, 54, 58, 69, 73, 79, 85, 86, 132, 191
Chapter 5: 5, 53, 59, 60, 61

M

mammals
Chapter 2: 37
Chapter 3: 55, 56, 57, 73, 102, 103, 104, 106, 107
Chapter 4: 160, 164, 167, 175, 179, 180
Chapter 5: 94, 107

minority populations
Chapter 3: 93
Chapter 4: 129, 131

mitigation
Chapter 1: 5, 9, 20, 21
Chapter 2: 1, 2, 3, 5, 6, 7, 10, 11, 12, 14, 15, 20, 21, 29, 36, 37
Chapter 3: 22, 38
Chapter 4: 1, 7, 8, 18, 19, 24, 29, 35, 36, 37, 38, 39, 40, 41, 43, 44, 45, 46, 58, 62, 65, 86, 91, 94, 98, 105, 128, 131, 134, 137, 142, 144, 145, 147, 154, 155, 156, 157, 159, 160, 161, 162, 163, 168, 171, 172, 175, 176, 177, 178, 180, 181, 182, 183, 184, 187, 188, 190, 192, 195, 196, 197
Chapter 5: 3, 5, 7, 10, 11, 12, 13, 14, 15, 16, 17, 21, 22, 24, 28, 30, 31, 32, 35, 36, 37, 38, 39, 40, 41, 42, 44, 46, 49, 54, 55, 57, 58, 59, 63, 64, 65, 66, 68, 69, 70, 72, 76, 77, 79, 81, 82, 83, 84, 85, 86, 87, 89, 90, 91, 92, 93, 94, 96, 97, 98, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110

mitigation measures
Chapter 1: 21
Chapter 2: 1, 2, 3, 5, 6, 7, 10, 11, 12, 15, 20, 21, 36
Chapter 4: 1, 7, 8, 18, 19, 24, 29, 35, 38, 39, 40, 43, 44, 45, 86, 91, 94, 105, 128, 137, 145, 154, 155, 159, 160, 161, 163, 168, 171, 172, 175, 176, 177, 178, 180, 181, 182, 183, 184, 187, 188, 190, 192, 195, 196
Chapter 5: 3, 7, 10, 11, 12, 13, 14, 15, 21, 22, 28, 30, 31, 32, 35, 36, 37, 38, 39, 40, 42, 57, 65, 66, 68, 69, 70, 72, 79, 82, 83, 84, 85, 86, 87, 89, 92, 93, 94, 96, 97, 98, 101, 103, 104, 105, 107, 108, 109, 110

Mizpah Creek
Chapter 3: 30
Chapter 4: 51, 54, 55, 69, 73, 74, 81, 82, 83, 85

Musselshell County
Chapter 3: 5, 74, 76, 78, 79, 81, 86, 87, 88

N

neotropical migrants
Chapter 3: 103, 104

Northern Cheyenne Reservation
Chapter 1: 13
Chapter 2: 22
Chapter 3: 28, 41, 43, 48, 50, 57, 58, 60, 61, 62, 63, 64, 66, 69, 71, 72, 76, 77, 79, 93
Chapter 4: 13, 23, 28, 33, 38, 39, 40, 43, 44, 45, 46, 57, 64, 70, 72, 85, 91, 94, 97, 99, 100, 103, 104, 105, 106, 107, 109, 110, 111, 117, 123, 125, 126, 128, 129, 130, 132, 133, 134, 137, 138, 139, 140, 141, 142, 143, 150, 152, 153, 154, 156, 157, 171, 176, 177, 178, 182, 189, 192, 194, 196, 197
Chapter 5: 6, 8, 13, 14, 32

Northern Cheyenne Tribe
Chapter 1: 1, 2, 5, 10, 11, 12
Chapter 2: 2
Chapter 3: 3, 5, 28, 38, 41, 42, 48, 50, 57, 58, 59, 60, 61, 62, 63, 66, 67, 68, 69, 70, 71, 72, 87
Chapter 4: 1, 37, 48, 66, 93, 123, 128, 130, 154, 182, 193
Chapter 5: 3, 6, 7, 48, 61, 81, 117

Noxious Weeds
Chapter 2: 11, 12, 15, 32
Chapter 3: 98
Chapter 4: 98, 103, 104, 144, 145, 149, 150, 151, 153, 161, 163, 168
Chapter 5: 88, 90, 91, 95, 99

O

off-road vehicle
Chapter 3: 56, 74
Chapter 4: 136

Otter Creek
Chapter 3: 30

P

pallid sturgeon
Chapter 2: 39
Chapter 3: 111, 112, 113
Chapter 4: 182, 189, 194
Chapter 5: 2, 101, 107, 110

Park County
Chapter 3: 27, 76, 78, 79, 81, 86, 88, 101, 111
Chapter 4: 10, 11
Chapter 5: 5, 39, 59

per capita income
Chapter 2: 34
Chapter 3: 41, 42, 50, 87, 88, 93
Chapter 4: 112, 115, 116
Chapter 5: 71, 77, 80

peregrine falcon
Chapter 3: 107
Chapter 4: 162
Chapter 5: 96

permits
Chapter 1: 1, 6, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18
Chapter 2: 3, 4, 10, 11, 14, 29, 38, 39
Chapter 3: 3, 20, 39, 42, 68, 93
Chapter 4: 2, 10, 14, 16, 17, 19, 46, 50, 58, 61, 62, 65, 75, 88, 91, 102, 139, 140, 145, 160, 169, 182, 183, 189, 191, 194, 195
Chapter 5: 7, 10, 12, 13, 14, 15, 29, 30, 32, 35, 36, 38, 42, 43, 44, 45, 46, 47, 49, 50, 51, 53, 54, 60, 61, 63, 64, 65, 84, 86, 89, 97, 117

planning criteria
Chapter 1: 2
Chapter 5: 1

Powder River
Chapter 1: 1, 2, 5, 9, 12, 19, 20, 21, 22
Chapter 2: 1, 3, 4, 5, 16, 27
Chapter 3: 1, 5, 6, 7, 8, 9, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 25, 27, 29, 31, 32, 38, 44, 45, 48, 52, 54, 58, 61, 62, 64, 72, 74, 76, 78, 79, 80, 81, 85, 86, 88, 92, 95, 97, 101, 104, 107, 108, 110, 111
Chapter 4: 2, 5, 8, 9, 10, 11, 12, 15, 20, 42, 47, 50, 51, 52, 53, 54, 55, 56, 58, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 72, 73, 75, 77, 79, 81, 82, 83, 84, 85, 86, 89, 90, 91, 98, 102, 103, 104, 113, 119, 120, 121, 122, 123, 130, 131, 139, 145, 147, 148, 150, 155, 162, 163, 172, 184, 185, 187, 191, 193, 194, 195
Chapter 5: 1, 4, 5, 8, 9, 10, 11, 14, 16, 19, 21, 30, 33, 34, 35, 39, 41, 42, 43, 46, 47, 49, 50, 51, 52, 53, 54, 55, 60, 61, 63, 65, 66, 71, 79, 80, 83, 86, 87, 97, 98, 107, 108, 110, 118

Powder River County
Chapter 3: 5, 58, 76, 78, 79, 81, 86, 88, 101
Chapter 5: 71, 80, 118

prairie dog
Chapter 2: 37
Chapter 3: 57, 72, 74, 103, 104, 106, 107, 108
Chapter 4: 160, 162, 165, 167, 168, 169, 171, 172, 175, 181
Chapter 5: 2, 95, 103, 104, 107, 110

preparers
Chapter 5: 121

public participation
Chapter 5: 1

R

raptors
Chapter 2: 15, 37
Chapter 3: 103, 104
Chapter 4: 160, 161, 165, 167, 170, 172, 173, 179, 180, 181
Chapter 5: 96, 98

reasonable foreseeable development scenario
Chapter 5: 33

reptiles
Chapter 2: 37
Chapter 3: 57, 73, 105
Chapter 4: 160, 164, 179
Chapter 5: 107, 108

rights-of-way
Chapter 2: 2
Chapter 3: 43
Chapter 4: 96

Rosebud County
Chapter 3: 5, 50, 71, 76, 77, 78, 79, 81, 86, 87, 88, 93, 101
Chapter 5: 20, 80, 118

Rosebud Creek
Chapter 3: 27, 28, 30, 53, 54, 62, 63, 65, 66, 67, 69, 72, 111
Chapter 4: 51, 55, 56, 64, 70, 71, 72, 73, 74, 79, 80, 84, 85, 86, 93, 132, 133, 139, 140, 141, 193
Chapter 5: 50, 56, 84

S

sage grouse
Chapter 2: 15, 37
Chapter 3: 57, 72, 104, 105, 106
Chapter 4: 160, 162, 165, 167, 170, 172, 173, 175, 180, 181
Chapter 5: 96, 98, 99, 100, 101, 103, 104, 105, 106, 107, 108, 110

shrublands
Chapter 2: 35
Chapter 3: 97, 102, 105
Chapter 4: 144

Special Status Species
Chapter 1: 21
Chapter 2: 11, 13, 15
Chapter 3: 57, 71, 72, 108, 109, 112
Chapter 4: 181, 182, 183, 189, 190, 192, 194, 195, 196, 197
Chapter 5: 57, 99, 108

Species of Concern
Chapter 2: 37, 38
Chapter 3: 72, 98, 99, 102, 104, 105, 108, 109
Chapter 4: 144, 145, 147, 149, 150, 151, 152, 153, 154, 160, 161, 168, 169, 170, 171, 172, 175, 176, 177, 178, 179, 181, 182, 189, 194
Chapter 5: 57, 89, 96, 97, 104, 105, 107

Stillwater County
Chapter 3: 74, 76, 78, 79, 81, 86, 88, 104
Chapter 5: 78

Sweetgrass County
Chapter 3: 76, 79, 81, 86

T

taxes
Chapter 2: 34
Chapter 3: 49, 59, 60, 87, 89
Chapter 4: 112, 113, 116, 117, 122, 123, 124, 125, 126, 127
Chapter 5: 34, 70, 71, 73, 75, 77, 79, 81, 82

Threatened and Endangered Species
Chapter 1: 22
Chapter 5: 2, 104, 121

Tongue River
Chapter 1: 12
Chapter 2: 6, 10, 26, 30
Chapter 3: 5, 9, 10, 16, 19, 22, 27, 28, 30, 38, 39, 41, 46, 52, 53, 54, 58, 61, 62, 63, 64, 65, 66, 67, 68, 69, 71, 72, 74, 104, 110, 111
Chapter 4: 12, 47, 48, 51, 52, 53, 57, 58, 64, 67, 68, 72, 73, 74, 75, 76, 77, 78, 84, 85, 86, 89, 92, 93, 94, 129, 132, 133, 134, 137, 139, 140, 141, 173, 183, 184, 187, 188, 189, 190, 191
Chapter 5: 5, 6, 35, 44, 51, 52, 54, 55, 56, 57, 59, 61, 69, 84, 86, 91, 100, 102, 103, 106, 109, 119

Treasure County
Chapter 3: 76, 77, 78, 79, 81, 86, 88, 104
Chapter 5: 119

U

unemployment
Chapter 1: 21
Chapter 2: 34
Chapter 3: 41, 42, 48, 49, 50, 59, 86, 87
Chapter 4: 112, 113, 115, 117, 119, 124, 125, 127

upland game birds
Chapter 3: 57

W

Wasatch Formation
Chapter 3: 9, 16, 17, 19, 54
Chapter 4: 12

waterfowl
Chapter 3: 27, 42, 103, 104, 107
Chapter 4: 160, 168
Chapter 5: 97, 105

Wheatland County
Chapter 3: 76, 78, 79, 81, 86, 88

Wilderness Study Areas
    Chapter 1: 22
    Chapter 3: 101

workforce
    Chapter 3: 87

Y

Yellowstone County
    Chapter 3: 5, 49, 50, 73, 76, 78, 79, 81, 86, 88
    Chapter 5: 20, 120

Yellowstone River
    Chapter 3: 27, 29, 51, 53, 61, 101, 103, 104, 107, 109, 110, 111, 113
    Chapter 4: 56, 57, 66, 69, 70, 71, 72, 81, 83, 184, 194
    Chapter 5: 5, 43, 50, 55, 56, 59, 61, 73, 87, 101

☆ U.S. GOVERNMENT PRINTING OFFICE: 2002 — 573-102 / 68003 Region No. 8